JOURNAL OF GAS LIGHTING, WATER SUPPLY, &c.

EDITOR & PUBLISHER: WALTER KING. OFFICE: 11, BOLT COURT, FLEET ST., LONDON.

VOL. CXX., No. 2584.—TUESDAY, NOVEMBER 19, 1912.

EDITORIAL NOTES.

Residuals Restriction Inquiry.

THE parties who are, on the one hand, prosecuting and, on the other hand, resisting the proposal to restrict the operations of gas undertakings in respect of their residual products were *vis-à-vis* with the Joint Committee of the Houses of Parliament last Tuesday. It was a purely formal meeting, at which, however, there were the elements for the conclusion that both sides intend to make a stiff fight for a successful issue their own particular way. Before the parties were admitted to Committee Room "A" of the House of Lords, the Committee had a private deliberation, at which Mr. J. W. Hills, who represents Durham City as a Liberal Unionist, and who is by profession a solicitor, was elected Chairman, and the mode of procedure was determined upon. The chief representative—through his unique simultaneous triple presidency—of the professional, the commercial, and the manufacturing interests of the gas industry (Mr. Corbet Woodall) was an interested spectator of the brief proceedings that followed the admission of the parties to the Committee-room; and we remembered as the formalities for the inquiry were being finally fixed how the President, in his evidence on one of the Bills during this eventful session, stated that, not so much on behalf of the large gas undertakings as on behalf of the small ones, he was prepared to resist to the utmost the intrusion of the chemical manufacturers on the liberties of the gas industry in dealing in any manner that is most profitable to gas undertakings with the secondary products. To so deal is their legitimate duty. But since then the view has broadened. It has been seen more clearly at every succeeding stage that the chemical manufacturers are intent upon one purpose—and one only—and that is to confine to themselves the markets for crude liquid residuals and spent oxide, and so to enjoy to their private advantage an absolute rule over prices. It is a matter the gas industry as a whole cannot possibly tolerate, and therefore the appeal to Parliament for justice and the preservation of open markets, or of conditions that will prevent the non-statutory chemical manufacturers obtaining dominant control over the residual products where they are not worked up by gas undertakings. It can readily be seen that, if the chemical manufacturers realize their ambitions in this direction, so much the worse will it be for those gas undertakings that work up their own residuals. If the associated chemical manufacturers can secure from all other undertakings crude material on their own terms, they will be much more serious competitors with the gas undertakings that produce finished products. The very fundamentals of free trade will be destroyed.

It must not be forgotten that this inquiry represents the final fight in Parliament over this question. Whatever the verdict of the Joint Committee, it will be the guide both to the Parliamentary Authorities and to Select Committees in future. If the gas industry gains the day, if it convinces the Committee that it is not in the public interests nor in those of the industry, that this extraordinary restriction should be imposed upon it for the commercial and financial benefit of a combination of manufacturers and traders, then it will be no use the chemical manufacturers making further fights on individual Bills; if, unfortunately, the Committee should determine otherwise, then the gas industry will have to accept the decision. The Gas Companies' Protection Association (acting we take it in conjunction with the Institution of Gas Engineers) and their Parliamentary Agents (Messrs. W. R. Cooper and Sons) give expression to their recognition of the importance to the gas industry of the result of this contest by the strength of their legal representation. No one has a greater title to lead for the gas industry than Mr. Balfour Browne, K.C., in a matter that lies at the very roots of its interests. With him there is Mr. C. C. Hutchinson, K.C., who has taken part in much parliamentary warfare on the side of the industry; and there is also Mr. A. M. Paddon, who bears a name that has for many decades had high position in the industry, and he is, of course, himself in and of the gas industry—having originally had experience on its engineering side, and being now a gas administrator, in addition to specializing in gas affairs at the Parliamentary Bar. It is expected that the Association of Municipal Corporations will also be represented at the inquiry. We hope they will be, as this is a matter for the whole gas industry, irrespective of the nature of the ownership of its units; the municipal corporations possessing gas undertakings being as deeply concerned in the question as any gas company. But the corporations have to be consulted, and instructions obtained from them by the Parliamentary Agents for their Association (Messrs. Sharpe, Pritchard, and Co.). We cannot conceive of there being any doubt regarding the gas-works-owning corporations coming forward and participating in this inquiry, and that with excellent effect. The gas companies and the municipal corporations together ought to make a strong showing.

It is evident that the Alkali Manufacturers' Association intend to make a determined stand for commercial advantage. If they lose, they will be in exactly the same position as before for doing a lucrative business; if they win, they will be placed in a position of commercial superiority to which they have no right, which under similar circumstances is without precedent, and which will be prejudicial to the interests of the public and of the gas industry. The Alkali Manufacturers will be represented by Mr. J. D. Fitzgerald, K.C. (who fought for them so assiduously during the session), and by Mr. Honoratus Lloyd, K.C. Mr. Lloyd, as leading Counsel for various Gas Bills during the session, resisted the imposition of the chemical clause, and some of his strongest points in argument cross the mind now that it is known he has gone over to the other side, at the critical stage, to argue in favour of the imposition of the clause.

The only real point in question when the parties and the Committee were face to face was as to when the inquiry should commence. Never has greater alacrity been shown in respect of a parliamentary inquiry than over the preparations for this one. It was only the other day the representatives of the House of Commons were selected for the Committee; immediately afterwards the House of Lords confirmed the nominations from their own body of representatives on the Committee. On the very heels of this came the announcement of the date for the first formal sitting of the Committee for the settlement of preliminaries. The Committee, we believe, were quite prepared to proceed to business the following day; but representations to the authorities resulted in the point as to the commencement of the sittings being left to the determination of the Committee. They thereupon proposed to begin to-day; but all the parties found next Tuesday a more suitable date. The evidence for a serious inquiry of this nature needs some final adjustment and arranging. The gas industry has already prepared the ingredients for its case; but a little time is necessary for synthesizing them. The brief respite before starting the proceedings will mean the more profitable use of the time devoted to the sittings. There are, too, the municipal authorities. They could not be brought into line without time for the purpose. Mr. Fitzgerald also holds a brief that he feels honour-bound to see through next week. Therefore the 26th inst. was adjudged by all to be the best date for the beginning of the proceedings; and the Committee were generously compliant. It is not thought likely that more than three days' sittings in two succeeding weeks will be required for the hearing of evidence and the speeches of Counsel. But at the same time the gas industry has to place the aspects of the case fully before the Committee. That is one of the purposes of the inquiry, as an investigation of the matter in all its varied phases has been denied up to the present—the matter having been discussed from the narrow point of view of individual concerns, instead of from that of the broader industrial and public aspects, and from the point of view of the present and not from that of

the future. There is the opportunity now for trying to correct the legislative error of the past few months; and we earnestly hope the result will be favourable to the gas industry.

The Earlier Street Lighting Tests in Manchester.

Proceeding with our examination of Mr. Pearce's report on the street-lighting tests made in Manchester previous to the calling-in of Messrs. Jacques Abady and Haydn Harrison, we see how it came about that the "Metroflam" trial flame arc lamps in Portland Street were fitted—as they were never intended to be fitted—with "Angold" clear inner and outer globes, with the lower portion only of the outer globes partially and modestly obscured. It is perfectly manifest from what took place that the lamps, as originally fitted with opalescent globes, could not even compete with the defectively fitted high-pressure lamps in Princess Street. It is common practice that flame arc lamps should be fitted with opalescent globes; and the practice has good fundamental reason. The opalescent globes assist in deadening somewhat the defects of the restlessness of the lights, and the abominable glare. To depart from the opalescent globe is to further transgress with flame arc lamps the laws of scientific illumination, and to produce a gross form of lighting which no electrical man who was not exceedingly hard-pressed by competition would voluntarily tolerate. Mr. Pearce obviously recognized that using the "Metro-"flam" lamps in a rational manner would produce defeat on the point of volume of illumination at or near the street surface—quite apart from the superior quality and the more even distribution of the illumination of the lower candle-power high-pressure gas sources of light. We see this in Mr. Pearce's statement that "the results of the various "tests further show that the use of clear globes (both inner "and outer), with the lower portion of the outer globe partly "obscured, is probably the simplest, cheapest, and most "satisfactory method of adapting the natural polar curve "of a flame arc lamp to the requirements of modern street "lighting, *provided that the lamp is fixed at a sufficient height.*" The last words are significant. The point is, what is a "sufficient" height? Illumination on the horizontal plane near the ground level and the glare and flickering of the source are contending factors in forming a decision. We maintain, however, that the height should be one at which people walking in the street have not their eyes tormented by the flickering and glaring light of flame arcs fitted as are these Portland Street ones with practically plain glass globes. If people walking through the street experience unpleasant visual sensations with the lamps at 27 ft. 6 in. above the road surface, how much more must drivers of vehicles experience them who are raised several feet nearer the light source. This is not right. The height should be fixed at a point at which the sensations referred to are removed. But Mr. Pearce could not afford to do this. The reason is not far to seek. With the "Angold" plain glass inner and outer globes only slightly obscured at the bottom, the flame arc lamps could then only give approximately the same illumination at the testing-level—Messrs. Abady and Harrison agree—as the high-pressure gas-lamps, which were developing, through loss of pressure from the defective fittings between the compressor and the lamps, only 27 candles per cubic foot of gas. That is a condition the flame arc lamp advocates now have to meet; and it is a condition upon which the Manchester street illumination trial and testings have thrown a very powerful light.

If opalescent globes had been retained (as they ought to have been) to mitigate the glare and unsteadiness of the light from the flame arc lamps, what would have been the effect upon the volume of illumination in Portland Street? The transit from the more rational and defect-covering form of flame arc lamp globes to the irrational plain (or practically plain) globes gave, Mr. Pearce says, an increase of over 50 per cent. in the light as measured at an angle of 20° below the horizontal, with the photometer 5 feet from ground-level. This means (taking the tests of the two experts and those of Mr. Pearce himself) that, if this transgression of rational use had not taken place, the flame arc lamps would have been hopelessly out of it, on the evidence of all the photometers, in comparison with gas lamps developing only 27 candles per cubic foot. As a matter of fact, the candle-feet illumination measurements show that, with the opalescent globes, the minima were only little more than half the minima with the plain globes, and seriously below the minima for the defectively connected high-pressure gas-lamps. Considering these points, it is amusing and it is certainly not a tribute to the intelligence of the people he refers to, to find Mr. Pearce saying: "It is interesting to "note that the alterations [from opalescent to 'Angold' "globes] have had the result of leading people to believe "that 6000-candle power lamps had been substituted for the "original 3000-candle power ones." If the high-pressure gas-lamps had been fitted properly, and if they had been giving double their present efficiency (as they ought to have been), the people to whom Mr. Pearce refers, who took the flame arc lamps as 6000-candle power ones, would probably have regarded the high-pressure lamps, giving their proper efficiency, as 12,000-candle power ones!

But what does Mr. Pearce mean by the "original" 3000-candle power lamps? Does he intend to convey by the term "original" that those lamps were giving 3000-candle power before the alteration was made? If so, and the candle power was increased by the change by 50 per cent., then the lamps ought to have been giving, when tested by Mr. Pearce, and afterwards by Messrs. Abady and Harrison independently, 4500-candle power. What, however, are the facts? That, with "Angold" globes, and all the abuse of rational lighting, we find, from the summary of the testing results in Mr. Pearce's report, that the maximum candle power he could obtain at an angle 25° below the horizontal, and with the photometer at 5 feet above the road-level, was 3660, and at about 20½° below the horizontal, 3590. But Mr. Haydn Harrison could only get, at angles of 20° to 25°, with his photometer at the 3 ft. 3 in. level, 2970 candles, and at 45° 3170 candles; while Mr. Abady obtained 2949 candles at an angle of 20°, and 1478 candles at 75°. As a matter of fact, using opalescent globes, Mr. Pearce could only obtain 2200-candle power at an angle of 20° measured 5 feet above the ground level. By what right then had these lamps to be "originally" called 3000-candle power ones, when fitted with the opalescent globes with which they were intended to be used?

We come to the illumination tests. Here the figures given in Mr. Pearce's report confirm the later ones by Messrs. Abady and Harrison, as well as the general conclusion, that, though the Princess Street high-pressure gas lamps, through defective fitting, were giving a much lower candle power (a maximum of 2550 candles at the angle of 12°, and of 2170 candles at 20°) than they were intended to do, and much lower than the flame arc lamps were doing, they were affording approximately equal illumination tested on the horizontal plane, 5 feet above ground level, or as calculated to the 3 ft. 3 in. level. With the flame arc lamps, Mr. Pearce's illumination figures, on the horizontal plane and at the 5 feet level, are: Maximum, 2·94 candle-feet; minimum in the centre of the roadway, 0·61 candle-foot; and minimum at side of roadway, 0·5 candle-foot. The calculated figures at the 3 ft. 3 in. level are: Maximum, 2·53 candle-feet; minimum at centre of roadway, 0·675 candle-foot (higher than at the 5-feet level!); and 0·5 candle-foot at the side of the roadway. These illumination figures, obtained with the plain glass flame arcs of higher candle power, show very little difference from those for the defectively fitted high-pressure gas-lamps. At the 5-feet level, the maximum illumination with the latter was 2·63 candle-feet; the minimum in centre of roadway, 0·58 candle-foot; and the minimum at the side of the road, 0·4 candle-foot. At the 3 ft. 3 in. level, the maximum, according to Mr. Pearce, was 2·05 candle-feet, the minimum in centre of roadway 0·575 candle-foot, the minimum at side of road 0·4 candle-foot. Why the maximum dropped between the two levels as much as 0·58 candle-foot while the minimum in the centre of the roadway only differed by 0·005 candle-foot is not quite clear.

These Manchester trial tests have brought home some important matters associated with lamp candle-powers and illumination results; and we are sure, in view of the importance of his contribution to the subject, Mr. Pearce will excuse us for having extracted and made public some of the salient points of his report. Thanks are extended to him for his testimony to the steadiness of high-pressure gas lighting, to the absence of shadows under the lamps, to their equality in illumination (though the lamps were not giving half their efficiency through a local defect) with that of flame arc lamps in which the laws of scientific illumination are violated, to the fact that as an illuminating agent the flame arc lamp fitted with opalescent globe is altogether out of the running with high-pressure gas-lamps, and to the further fact that it requires a lower candle power source of light with high-pressure gas than with flame arc lamps to give an equal

illumination on the horizontal plane at the 5 feet or 3 ft. 3 in. level from the ground surface. This all forms an excellent contribution to the subject of street illumination.

Reinforced Concrete in Gas-Works.

In the rapid flight of time, it does not seem many years since that, on the consideration of the question of the use of reinforced concrete in gas-works, it was thought that there was not an extensive field for its employment. To-day gas-works themselves have undergone, and are undergoing, considerable change; and with the change, and the large extensions necessitated by business expansion, and the requirement of new buildings for fresh mechanical and other processes, the economies of reinforced concrete have been, in many instances, largely introduced, with considerable advantage. Its strength and utility under all sorts of circumstances have been discovered; and the proof of utility in lessening the cost of foundations where the subterranean conditions are not of the best for heavy structural work, and in buildings of all kinds where there are large variations of temperature and considerable stresses and vibration, has caused an increasing adoption. The paper that Mr. J. Fisher prepared for the meeting of the Southern District Association last Thursday, presented the general subject in a clear manner, and showed the importance of this type of construction, on considerations gathered from his study of the system and from the opportunities he has had for more particular investigation through the reinforced concrete work carried out by his chief (Mr. A. E. Broadberry) at the Tottenham Gas-Works.

As Mr. Fisher states, the considerable increase in strength resulting from the incorporation in concrete of only a small amount of steel is extraordinary. The combination of the properties of the two materials makes this method of construction in every way peculiarly fitted for buildings such as those in gas-works where various stresses, vibration, and differing temperatures all come into play. There is somewhat of an equality in the capacity for expansion and contraction between the two materials; and in this, combined with the power of cohesion of the concrete to the steel reinforcement (which cohesion is found to increase with life), we have in large measure the secret of the power of reinforced concrete to offer effective resistance to the tensile or shearing stresses and the compressive forces to which a structure may be exposed. There is a mutuality about the combination which appeals strongly to the engineer—the steel performing a part of which the concrete is incapable, and *vice versâ*. Another singular observation is that the concrete, when in combination with its steel reinforcement, appears to lose some of its brittleness, and to assume a greater elasticity. This is shown by the fact that there can be a fairly considerable deflection before any actual breaking of the concrete takes place. Then, again, that buildings constructed on this system are better capable of withstanding vibration than those as ordinarily constructed, is due to the monolithic character of the structure. Of course, in all reinforced concrete structures, care must be exercised in the distribution of the steel; and Mr. Fisher himself, while not suggesting that for any ordinary work it is necessary—it is quite unnecessary—to have recourse to any of the patented systems, hints that, for important work, it is well to engage the experience of specialists in the work. The paper is full of useful suggestion in regard to the construction of foundations, floors, columns, walls, and roofs, embankments and retaining walls, and tar and liquor tanks. In connection with walls, we are passing from the plain to the ornamental in this reinforced concrete work. Mr. Fisher described how a tendency is growing to make a special framework of reinforced concrete, and filling with panels made of small moulded concrete blocks, which give the appearance of stone work. This construction makes strong walls of very effective appearance. A good (and new) example of this is to be found at the Tottenham and Edmonton Gas-Works.

There is not the same confidence expressed by Mr. Fisher as to the use of reinforced concrete for gasholder tanks. He is aware that the system has been employed for the purpose instead of brick and puddle; but he adds that "it would "be unwise to say more than that it seems a suitable form "of construction for, at any rate, small and medium sized "tanks." Touching this, there is, of course, the experience of Mr. W. H. Bradley, the Chief Engineer of the Consolidated Gas Company of New York, in the successful construction in reinforced concrete of two 300 feet diameter gasholder tanks and one 189 feet in diameter. The time required in their construction was considerable; and this question of time is an important factor in cost to be set against the system in comparison with other methods of construction. There is the point, too, that tanks of large diameter must come under the designation of "important "construction," which requires specialist treatment. One authority on the construction of large circular tanks has very emphatically pointed out the necessity of keeping in mind the varying tension from point to point in the steel reinforcement due to the difficulty of obtaining a true circle in the field. One has quite a different "proposition" to deal with in such work from that involved in the construction of foundations or walls or floors, for an ordinary building. Nothing in the nature of careless work will do. However, coming down to gasholder tanks of smaller diameter, there is still dissatisfaction in the minds of some engineers as to whether, on the balance, it is not preferable to construct steel tanks. That is a matter which must be largely dominated by local conditions, and by working and life experiences elsewhere, in regard to which in connection with steel tanks some excellent testimony is accruing. In the matter of the longest experiences with circular tank work in reinforced concrete, reference must be had to water engineers, especially in America. However, for ordinary structural work, in reinforced concrete there is a commercially cheap and durable system, particularly suitable to the conditions appertaining to most gas-works, and that is the point of Mr. Fisher's useful contribution.

Retort-Furnace Feeding, and other Details.

Compressed into a short paper submitted at the Southern Association meeting by Mr. G. M. Gill, the Engineer of the Wapping Station of the Commercial Gas Company, were three or four subjects appertaining to retort-house management and economy which show the initiative capacity of the author. Consideration for small things in industry as elsewhere tells; and in the retort-house especially a number of comparatively small tributaries to leakage of (say) time, heat, and materials may be converted into tributaries of economy, with a good accumulation of effect. A few points of the kind are discussed in Mr. Gill's paper. The modern retort-house in its main work is now so largely mechanically controlled that little thought has been expended upon further advance in this direction, except in the matter of improvement upon present applied methods. There is, however, the furnace work—work which is arduous, and which exposes the firemen to considerable heat. Mr. Gill has introduced a simple method of mechanically doing this work, expeditiously, and without the labour and exposure necessitated by hand work when dealing with the incandescent coke as drawn from the retorts. The furnace-charging machine can be fitted to any retort-charging machine or pusher running on the furnace side of a bench; and it is also now being made, by Messrs. W. J. Jenkins and Co., to work in conjunction with the De Brouwer machinery. From this it is seen that there are no limits to the utilization of the new invention with any form of existing horizontal retort-charging machines.

The advantages that readily suggest themselves as accruing from the mechanical feeding of furnaces are materialized daily in the use of the machine at Wapping. On the point of expeditious work, for example, 9 cwt. of coke can be charged into a furnace in 25 seconds; while the furnaces of eight settings of ten retorts on which the machine is operating are charged in eight minutes—from the start of work on the first to the finish of the eighth furnace. Moreover, the firing-draw can be now carried out by the same number of men as the ordinary draw. On this latter point, however, Mr. Thomas Glover, while not suggesting the application of his criticism to Wapping, makes a point of what is a fact, that in many works the retort-house men have now been brought to the irreducible minimum for safety; and he rather inclines to the wisdom of having something in the nature of a little margin in labour than relying on a provision that makes no allowance for sickness and emergencies. Even so, the machine has other claims than that of economizing labour.

Among the other matters introduced in the paper is a plan adopted by Mr. Gill for dealing with the liquor condensed in the retort-house—the object being, on the one hand, to reduce the temperature of this liquor so as not

to increase the temperature of the liquor stored and cause loss of ammonia; and, on the other hand, to facilitate the work of keeping the hydraulic main and the tar outlet pipes in good order. The subject of preventing radiation from the retort-benches is also treated upon in the paper; and though Mr. Gill speaks highly of the material that he employs for the purpose, and Mr. A. F. Browne of a brick adopted at some of the works of the South Metropolitan Company, there certainly seems to be room for the development of suitable material for application to this economizing object.

Turned-and-Bored and Steel Pipe Joints.

Ordinary pipe-laying work for gas distribution is not a subject that has had any prolific consideration of late years at the meetings of our technical organizations—such papers as have been brought forward having mainly dealt with the special question of the laying of mains for high-pressure work. That there is a vast amount of interest to be derived from ordinary gas-main work in a busy crowded area to-day is easy to conceive even by those engineers whose lives are spent in localities away from the madding rush and conditions of modern city and large town life. The interest was evidenced, in a considerable measure, by the paper that Mr. W. George Head, the Distributing Engineer of the South Metropolitan Gas Company, presented to the Southern District Association on Thursday, every line of which paper contained some point of practical interest. The fore part of the contribution was occupied by the advocacy of the turned-and-bored form of joint which the South Metropolitan Company commonly use in place of the more general open lead joint, which turned-and-bored joint is run in front with lead in the usual way—the turning and boring (as the Chairman of the Company, Mr. Charles Carpenter, explained during the discussion) being practically a substitute for the yarning operation. The paper also included a comprehensive account, plainly stated, of the methods adopted by the Company in their pipe-laying; and there are points bearing upon these, and especially upon the form of joint the Company favour, which it may be well to emphasize.

The Distribution Department and the pipe-work methods of the Company have become highly systematized on lines that are largely the outcome of experimental work and investigation; for neither in this respect nor in any other can the Company be accused of following fashion purely for fashion's sake. As to the form of joint that the Company have for long had in use, and now in common use, their experience with it extends back (though in a less standardized form) to their early days, and this experience covers a period when the conditions of South London have varied between (we might almost say) those existing in a village street and those existing in, as to-day, one of the most congested areas of London both above and beneath the surface of the roads. The character of the subsoil varies from marsh ground to heavy clay, with a variety of kinds intermediate. Many of the main streets are comparatively narrow, and contain huge sewers, the conduit system of tramways, and give place on the large scale to all the other conveniences of modern life that claim subterranean accommodation. A tube railway cuts through the centre of the Company's district, heavy dock and other riverside traffic passes through the streets, the tram service is heavier perhaps here than in any other part of London; and vibration is constant. The traffic from south of the Thames to north, and from north to south, is incessant. When these conditions are all considered, coupled with the fact that, as Mr. Head says, the unaccounted-for gas has only averaged, in the last quinquennium, 2·67 per cent., the ordinary criticisms that one would feel inclined to advance adverse to the use of the turned-and-bored joint (which extends over at least half the Company's distribution system) meet at once with a very substantial answer.

Some of the points that naturally cross the mind in considering the use of turned-and-bored joints in gas-main work were raised during the discussion of the paper. The effects upon the permanence and tightness of such joints of variations of temperature, of the expansion and contraction of clay, of subsidence, and the difficulties met with in work that has to diverge from a straight line, were all introduced. The Company's experience is so extensive that there is an answer to every point. Greater variations of temperature in the subsoil producing expansion and contraction of the joints will not be met with than is experienced with the pipes and connections used for the tar and liquor mains on the works. For these purposes the Company have evicted the ordinary lead joint, and have substituted the turned-and-bored form, with the result that, whereas "there used "to be many leaky joints, especially after a Sunday stop, "when the pipes cooled down and drew the lead joints, now "these are things of the past." This is a fairly complete reply to any question regarding the effect of variation of temperature. As to expansion and contraction, with settlement where the subsoil is of clay, and the naturally anticipated trouble with drawn pipes, the Company have thousands of turned-and-bored pipes laid in clay; but Mr. Head successfully surmounts any difficulty by laying the pipes at a sufficient depth so that trouble is not experienced in this regard. He does not tell us precisely what the depth is; but he does mention, in his reply to the discussion, that, at a depth of 2 ft. 6 in., or even 2 feet, the variation of temperature is so small as to be practically negligible. Of course, in areas subject to subsidence through underground workings, a different condition arises. Bearing upon the effects of subsidence, it is remembered that, following the great heat of the summer of 1911 and the subsequent heavy rainfall, the stability of property was considerably undermined in some parts of the Company's area where the subsoil is largely of clay; and it would be interesting if Mr. Head would say whether, under their abnormal experience, the turned-and-bored joints suffered more or less than the ordinary lead-jointed mains. The large exposure of the pipes to vibration through traffic has been already indicated, as have also the difficulties in the district of laying long continuous lengths of pipes in perfectly straight line. However one examines the question, the low leakage experience dispels the notion of any abnormal drawing of joints, though the conditions are such as to favour trouble if such joints were susceptible to it. But in this connection the practice of the Company must not be overlooked. The turned-and-bored joint is not used without break. As Mr. Head states in his paper, and again mentioned in his reply to the discussion, the practice is to make one joint in twenty of lead, and with large pipes one in twelve. Special converting pipes and other connections are also laid with lead joints. For large pipes, such as 48-inch ones, recessed turned-and-bored sockets are used as there is sometimes difficulty in obtaining the machined portion perfectly true. The recessed portion in this case is run with either cement or lead, and this forms an extra precaution.

The points bearing upon the subject, and made in Mr. Head's paper, are too numerous for special mention here; but he makes out an excellent case for the Company's choice of joint on the working experience alone. In the matters of facility, quick running, and moderate cost, the turned-and-bored joint on the Company's standard conditions possesses advantages that cannot be claimed by the more ordinarily used lead-jointed pipes. However, the whole thing resolves itself into a question of appropriateness to local conditions; but when gas engineers considering the matter interrogate themselves as to what conditions exist in their areas that are not covered by the diverse circumstances of the extensive South London district, many will find themselves hard put to it, after this paper, to satisfy themselves that the old open lead joint system is superior to the turned-and-bored joint.

The jointing of steel tube for high-pressure work has fairly frequently been forward of late years, and the respective merits of lead wool and run lead joints have been debated—still leaving both forms with their adherents. Mr. Head's final selection is a joint composed of the two. A strand of lead wool is followed by one or two strands of yarn, and this is succeeded by lead wool, with the final ½ inch run with soft lead. Before any appreciable expansion of the socket can take place, through the use of molten metal for this finishing surface of lead, care is taken to immediately cool the joint with water. The caulking throughout is by specially designed sets; and proper tools for the work is an emphasized point. The efficiency of the joint is proved by the extensive successful experience of the district. This part of the paper like the other portions is full of very useful hints. Mr. Head insists, among other things, on properly designed sockets for these steel high-pressure mains; and an indispensable condition to his mind is that they should be slightly tapered inwards towards the face. By doing this, in the event of any drawing movement, the lead will wedge itself tightly in the socket. The

steel tube makers will also notice Mr. Head's suggestion that it would be an excellent and acceptable thing on their part if they would provide a special fitting, so as to facilitate the repair of steel mains when they happen to be accidentally punctured.

The paper has in it so much that is excellent that it is only possible to make a cursory examination of points in it; but it can safely be said that it is a contribution of the nature that will carry interest to, and serve a highly useful purpose in, many places now and in the future.

Purification Processes.

The fact that our pages are now constantly introducing to the notice of readers the subject of the purification of gas shows the large revival of interest there is in this particular line of the work of gas manufacture. In our issue for Nov. 5, Mr. H. Howell, of Messrs. W. C. Holmes and Co., introduced, by drawings and description, the improved Holmes plant for the purification of coal gas in closed vessels by means of ammonia, in which plant the inventor has essayed to override the difficulties that Claus and others experienced in their efforts in the same direction. In this new plant tower scrubbers have no place, and washer-scrubbers are employed. This change has enabled the plant to be designed so that the liquor gravitates through the plant, thus obviating the pumping that was necessitated by the use of tower scrubbers in the Claus plant, with the consequent loss of ammonia. Further the liquor in this new scheme of plant is compelled in its circulation to come into more intimate contact with the gas than in the Claus plant, with, among other good effects, the prevention of the formation of pockets of carbonate of ammonia. The plant, however, has not, so far as is known, been put to practical test on the working scale; but Messrs. Holmes will certainly not meet with any great difficulty in arranging for this to be done. The only criticism that has yet been made at any meeting in the gas industry was by Mr. J. M'Leod, of Greenock, in a review of modern purification proposals that he submitted at the meeting of the Western District of the Scottish Junior Gas Association last Saturday week. The drawings of the Holmes arrangement, he considered, showed a somewhat cumbersome and complicated looking plant. Mr. M'Leod also passed some critical observations on the O'Neill system of continuous purification with ammoniacal liquor, the Burkheiser process, and the Evans process, now in operation at the South Metropolitan Gas-Works. In connection with the last-named he asks a question as to the likelihood of the formation of nickel carbonyl. There is also reference in the paper to the Paterson liming process. But with all the fascinating proposals before him, Mr. M'Leod finds the oxide one conforming with modern practice quite good enough for him.

Air in Purification.

There are numerous interesting points in the paper that Mr. C. V. Townsend, of Wakefield, read before the Yorkshire Junior Gas Association last Saturday. The basis for the paper was supplied by the new purification plant at the Wakefield Gas Company's works, and by the experiences with it—especially in the use of air for revivification *in situ*, and in the application of the rotation system. The whole paper makes an excellent story, worth reading. There is only one point to which any reference need be made here, and that is in connection with the part of the paper alluding to the use of air for revivification *in situ*. Mr. Townsend describes this as a "modern" practice. It was early in the "Eighties" that the practice was first introduced by Mr. J. G. Hawkins; and the practice to-day is rather more general than we fancy Mr. Townsend thinks. He raises the old question over which there has been controversy as to which is the best place to introduce the air. He condemns its admission on the vacuum side of the exhausters; and his argument runs thus: If the vacuum decreases, the amount of air drawn in also decreases; while if the vacuum increases, the volume of air drawn in also increases. Assuming that the vacuum remains constant, the amount of air, he says, will also remain constant, and thus will not vary in proportion to the make of gas; so that the percentage of air admitted will never be constant unless both the vacuum and the make of gas are also constant. Mr. Townsend is here criticizing very large practice and experience. In many gas-works, the air is drawn in at the condensers; and this has been the practice for years, without any trouble being experienced. If the exhausters are governed by the vacuum in the foul main, then when the quantity of gas decreases, the governor checks the steam supply, which reduces the speed of the engine, and so the pull is lessened. The contrary happens if the volume of gas increases; and, this being so, there is automatically a relationship established between the quantity of air admitted and the volume of gas passing. Of course, there may be a little fluctuation; but a daily test with a Bunte burette will assist in keeping matters fairly constant.

Another Point.

However, Mr. Townsend prefers (and we are not criticizing his preference, but only pointing out what is a disadvantage of his method) to introduce the air at the purifiers themselves; and for this purpose he connects to each set of exhausters a small exhauster with the necessary fittings to regulate the percentage of air proposed to be introduced into the purifiers. From the outlet of the small exhauster, a main is run for the purpose of introducing the air at any point decided upon near to, or at, the purifiers. The disadvantage of this plan would be very marked in large gas-works where the exhauster-house may be hundreds of yards from the purifiers; and when the experience of drawing in air at the condensers is compared with the provision of this additional small exhauster to each exhauster set and the length of main from it to the purifiers, it may be a question whether the extra expense is really necessary. We see that later on in the paper where Mr. Townsend speaks of keeping purifier-boxes warm in the worst of weather, he says that "it is true steam-coils can be introduced; but, like all other complications, they have their drawbacks." That is precisely what we feel regarding the plan he prefers for introducing air to the purifiers when applied to large works. There is agreement with his view that there is no particular information conveyed as to the work a purifier has actually done by merely stating the millions of cubic feet of gas that have passed through it. We heartily congratulate Mr. H. Townsend and the author upon the saving that has been effected at Wakefield by the new purification system, and by the change in purification practice that this enabled, though precisely one-half of the 1·09d. per 1000 cubic feet saved is represented by the abolition of lime purification.

Some Rating Statistics.

Once more, by the kindness of Mr. James Carter, the Borough Treasurer of Preston, we are able to publish some particulars from his annual compilation of statistics with regard to the rates levied for the financial year 1912-13 in various towns, the charges for domestic supplies of gas, water, and electricity, and the profits and losses on municipal undertakings by which the rates have been reduced or increased. The present is the twenty-eighth issue of the statistics; and the number of towns and metropolitan boroughs dealt with shows a large increase over its predecessors—the total being 132, as compared with 95 for the previous year. The places included are of all kinds, and all sizes; and a glance through the information given reveals some interesting facts. Of course, as so many more towns are included, the present return is not strictly comparable with the one which went immediately before it; but it may be mentioned that on this occasion there are fifteen places where the amount in the pound levied for rates is shown to be 9s. or over. This number compares with thirteen the year before, and twelve for the year preceding that. Norwich still remains at the head of the list, with 10s. 7d. in the pound, though West Ham and Stoke (each with 10s. 6d.) follow it very closely. Norwich is 1d. less on the present occasion, compared with a year ago; but the figure for West Ham is 7d. more. East Ham has gone down 1d., to 10s. This puts it on a level with Ilkeston; while, in addition to the places already named, it is behind Merthyr Tydfil (10s. 2½d.) and Lowestoft (10s. 1d.). The number of instances in which the rates amount to 8s. or more in the pound is 57 on this occasion, as against 37 and 33 for the immediately preceding years. The only places included in which the rates are 5s. or less in the pound are still Oxford (4s. 8d.) and Blackpool and Bournemouth (5s.). Of these, Oxford benefited to the extent of 7½d. in the pound from revenue-earning undertakings, and Blackpool 5d. On the other hand, Bournemouth incurred deficiencies by which the rates were increased by 1¼d. In the list giving the prices of gas for domestic lighting purposes, there are 25 places where the charge is 2s. or under per

1000 cubic feet, compared with 21 last year—the additions being Keighley, Luton, Rochdale, and St. Helens (Keighley and Luton appearing in the statistics for the first time this year). The lead in the matter of cheapness is retained by Widnes, with Sheffield still second. There are three places in the list which charge 6d. or more per unit for a domestic supply of electricity; Bury coming at the other end of the scale with 2¾d. Through the operations of reproductive undertakings, there are twenty towns in Mr. Carter's list (as against fourteen last year) which relieve the rates to the extent of 1s. or more in the pound. On the other hand, 55 out of the 132 towns are included in the list showing the amount in the pound by which the rates have been increased as a result of deficiencies on certain municipal enterprises. In seven cases the deficiency reached 1s. or more in the pound.

A London Club in Darkness.

It would usually be considered out of place to refer in the Press to occurrences within a club-house; but an article which has recently appeared in the "Illuminating Engineer" on "The Lighting of a London Club" has drawn attention to a particular case. It appears that the Committee of the Whitehall Club gave permission for measurements and photographs to be taken of the lighting in the new club-house in Princes Street, Westminster. The tests showed fairly satisfactory illumination; but this would appear to be in a measure due to the tungsten electric lamps being suspended at a somewhat low level in the rooms—a course which obviously has attendant disadvantages. The main point of our present reference to the lighting of this club, to which attention has thus been publicly directed, is, however, to mention that, owing to reliance having been placed solely on electricity, a considerable body of members and guests were put to serious inconvenience on Wednesday evening last. The occasion was that of a house dinner at which Mr. R. Elliott-Cooper, as President of the Institution of Civil Engineers, was principal guest. About a hundred members and guests assembled at the appointed time to find the entrance hall lighted by a single candle, and the rest of the premises in darkness save for the stray light penetrating the windows from the gas-lamps in the street. After some twenty minutes, in which various explanations of the untoward occurrence were offered by eminent members of the Institution of Electrical Engineers, who form a considerable proportion of the membership of the club, the supply of current was restored to all floors except the entrance floor, which remained lighted by candles for the rest of the evening. It is rumoured that the Engineer-in-Chief of the Westminster Electric Supply Corporation (Sir Alex. B. W. Kennedy) was among those who experienced the ill-effect of sole reliance on electric lighting.

The Sheffield Dilemma.

The Sheffield Corporation are in a serious dilemma over the position of the wiring and fittings department that they have been carrying on as an adjunct to their electricity supply undertaking. It will be remembered that they have an appeal pending against the decision of the Court of Chancery that declared to be *ultra vires* the carrying on of this supplementary business. Simultaneously, the uncertainty of the position was expressed by the incorporation in their Bill in Parliament this session of a clause to confer the necessary powers for the conduct of the business. This the House of Lords rejected. Now it seems that there are negotiations pending (during which the progress of the Bill has been suspended) on the favourable outcome of which the Corporation could go to Parliament, and pray for the re-establishment of the clause. In other words, the Corporation are trying to effect a compromise with the traders. But there is another side to this. The electrical contractors are warned that they had better come to terms as no less a legal luminary than Mr. Danckwerts has assured the Corporation of his confidence that he could win for them on a question of law an appeal against the decision of the Lower Court. This being so, there cannot be any great need for discussion with the contractors, nor for the suspension of the Bill, and the reintroduction of the clause. When the contractors critically examine the position, possibly they realize that the Corporation do not altogether share the confidence ascribed to Mr. Danckwerts; and doubtless the clever K.C. would be prepared to admit that he can recall cases in which similar expressions of confidence on his part have not always been endorsed by the event.

OBITUARY.

Mr. William Hutchinson, who until quite recently held the position of Indoor Superintendent of Water-Works with the Bolton Corporation, died at his residence in the town last Tuesday, in his seventy-second year. He was a native of Hull, and after considerable experience with the Lancashire and Yorkshire Railway Company, he secured the appointment with the Bolton Corporation in January, 1876. He held the position up to a few months ago, when he resigned owing to ill-health.

The death occurred last Thursday, at his residence at Trentham, of Alderman William Lowe Elliott, who had participated actively in the public affairs of Newcastle-under-Lyme. He entered the Council in 1895, was enrolled as a Justice of the Peace in 1901, and was elected an Alderman in 1907, which was the second year of his mayoralty. He was Chairman of the Gas and Finance Committees of the Council, and was the first Chairman of the Electricity Committee. Deceased was about fifty-three years of age.

The death last Friday, after only a few days' illness, of Sir Thomas Skewes-Cox, removes a very conspicuous figure in connection with the public life of Richmond—he having been Mayor, a Justice of the Peace, and an Alderman of the borough. He was also an Alderman of the Surrey County Council. He represented the Kingston Division of Surrey as a Unionist in Parliament from 1895 to 1906. His death calls for notice in these columns from the fact that he was a Director of the Richmond and Hampton Court Gas Companies.

Relative Costs of Coal and Oil as Fuel.

In the "Memorandum" for the year 1911 lately issued by Mr. C. E. Stromeyer, the Chief Engineer of the Manchester Steam-Users' Association, he deals with the relative costs of burning fuel or oil under boilers, and exploding oil or gas in engines. He shows that with the prices of oil now ruling, it will not be profitable to burn it in preference to coal until the cost of this has risen to 38s. per ton; but that oil can be profitably used in internal combustion engines whenever and wherever the price of coal exceeds 15s. per ton. He makes the following comparisons: Roughly stated, a first-class modern steam-engine utilizes about 12 per cent. of the available heat in the coal, resulting in (say) from 1·6 to 1·7 lbs. of fuel per brake-horse-power per hour during a week's work of 55 hours. If the boilers are to be fired by producer gas, for which purpose slack and dust can be used, then each brake-horse-power will require about 2 to 2·2 lbs. of coal. Internally-fired gas and oil engines are approximately twice as efficient as steam-engines, which means that they utilize about 25 per cent. of the available heat. Crude oil being 37 per cent. better than good ordinary coal, oil-engines should use only about three-eighths of the quantities of coal mentioned above—say, about 0·6 lb. per brake-horse-power. Then, however, as there are no boiler radiation losses overnight, a material saving results; and the oil consumption per week of 55 hours may be about 0·5 lb. per brake-horse-power. Petrol and similar internal combustion engines would require about 0·4 lb. Gas-engines have also about the same efficiency as oil-engines; but as there is a loss of about 20 per cent. in the producers, if these work day and night, and another loss of quite 10 per cent. if they have to stand idle overnight, the efficiency of gas-engines is only about 40 per cent. better than that of first-class steam-engines.

Wedding.—At the Friends' Meeting-House, Malton, the marriage was recently solemnized of Miss Mary Tobey, daughter of Mr. and Mrs. Henry Tobey, of The Mount, Malton, and Mr. Basil Doncaster, son of Mr. and Mrs. Samuel Doncaster, of Sheffield. The bridegroom is a Director of Messrs. Daniel Doncaster and Sons, steel manufacturers, of Sheffield; while the bride's father, as "Journal" readers are aware, is the Engineer, Manager, and Secretary of the Malton Gas Company.

Gas-Turbines.—At the first meeting for the present session of the Cleveland Institution of Engineers, held at Middlesbrough on Monday evening last week, the President (Mr. Henry Crowe) referred in the course of his address to the subject of gas-turbines. He remarked that, as the steam-turbine had replaced the reciprocating engine for the generation of electricity in very large units, these motors were now being built giving 20,000 kilowatts in one unit—engineers having recognized the advantage of the rotary over the reciprocating movement. Up to now it had been impossible to build a gas-engine to give anything approaching 20,000 kilowatts on one shaft; the largest now under construction being twin-tandem, giving 4000 to 4500 kilowatts. It was therefore quite natural that inventors should turn their attention to the gas-turbine. But though much useful experimenting had been carried out, by daring inventors—notably, Mr. Holzwarth, who had built gas-turbines of the explosion type which he rated at 1000 H.P.—its efficiency was lower than the gas-engine, which it appeared there was no fear of its superseding in the near future. Whether a combination of the Humphrey gas-pump and a turbine would prove a cheaper and more satisfactory method of producing electricity than that involving the use of gas-engines remained to be seen.

ELECTRICITY SUPPLY MEMORANDA.

For a "Wider Public"—Some Electrical Absurdities on Lighting—Pseudo-Dogma on Electric Cooking—Puerile Statements on Gas Heating—Metallic Filament Lamp Situation—An Electric Prepayment Meter Defect.

It is human to err. We have been labouring under the impression that "Electrical Engineering" was a technical paper; but last week it tried to make its ordinarily thin sides bulge out by a number of articles on the "Uses of Electricity," some of the components of which articles are of the type that might appeal to those perfectly ignorant on matters electrical, and in some respects mislead those not intelligent enough to weigh-up the relative advantages derivable from the use of gas and electricity for various purposes. The Editor of "Electrical Engineering" appears to recognize the lean, commonplace order of certain of the articles—at all events we hope, for his own sake, that he does, for he says in one place that the articles have been written for consumers and prospective consumers; and in another place he apologetically writes: "To the regular reader of 'Electrical Engineering' this portion of our number contains little that is new; but he will not blame us for attempting to impart to a wider public facts with which he is already familiar." We wonder how many members of that "wider public," outside the electrical fraternity, have caused the circulation of the paper to go up by the purchase of copies. The excuse given for the publication of such articles, containing much unadulterated simplicity, with a fair sprinkling of foolish stock sayings of electricians, in a serious technical paper is far from adequate. Here is a sample of the latter in the "Electric Lighting" article: "With electric light, no consumption or vitiation of the atmosphere takes place; and the wave of hot and nasty air felt on entering a room in which the gas has been lighted an hour or two is not felt." It evidently has not occurred to the mind of the person responsible for the article that, where there is consumption of air for lighting or heating purposes, there must be a replenishing of the supply; otherwise the lights and fires would be extinguished. This replenishing of the supply causes a movement and change of the air, which is good for human beings. The places where we have met with hot and nasty air—the stagnant air against which modern medical men protest—are rooms in which the cyclic action does not take place that must occur with gas lighting and heating. There has been a good deal heard about this stagnant poisonous air in meeting-places that are lighted electrically; and additional electric fans have had to be installed in the attempt to cure the filthy atmospheric condition.

Among other wonderful information in the same article for "Electrical Engineering" readers, is a table showing the cost of "lighting" a 16-candle metallic filament lamp for 100 hours. It is one of the common dodges of electrical people to take a small unit on which to work out costs, and to calculate on as near 1 watt per candle power as their consciences will permit to them. It would be interesting to have the Editor of "Electrical Engineering" up for a little examination as to the extent of truth he fancies there is in the following sentences: "No comparison can be made with incandescent gas-burners. Even under the most favourable conditions, the life of an incandescent gas mantle is but a fraction of that of an electric lamp, and while the modern electric lamp can withstand vibration and a certain amount of rough handling, and is absolutely unaffected by draught, the gas mantle soon falls to pieces unless it is thoroughly protected from draught, vibration, or accident. Moreover, the gas mantle falls off rapidly in the light-giving properties after the first few days' use." Did anybody ever read softer stuff than that in a technical paper? An incandescent gas-burner lasts for years; an electric lamp does not. It is only the mantle that requires renewal when fracture occurs—and not through the light-capacity of the mantle itself perishing. In the writer's own house, with thirty inverted burners or thereabouts, he has only had two mantle renewals since the beginning of March last, and the house has never been unoccupied during the period. We have authoritative information that on an extensive railway system, the experience is that, on an average, mantles last two months where there is little violent movement, while those on local and suburban service require renewing about once every five weeks. It would really add to the sum of scientific knowledge if the Editor of "Electrical Engineering" would tell us why a structure which has been produced by a base of cotton or artificial silk and impregnated by a solution of (say) 99 per cent. thorium and 1 per cent. cerium should fall off rapidly in its "light-giving properties" after the first few days' use. We should like our friend to explain how heat acts destructively upon the components of the mantle after the fabric is burnt out? Is it not rather silly to talk about things that one does not understand in the loose way that is found in the article under notice—prepared, too, for a "wider public" than usually peruses "Electrical Engineering?" There need be no diminution of candle power using a bunsen burner and a mantle; and an economical light can be obtained by them of a lower intrinsic brilliancy and of higher quality than can be obtained from the metallic filament lamp.

Last week we were holding up to admiration Mr. A. Hugh Seabrook, the General Manager of the Marylebone Electricity Department, for the highly ethical tone of his addresses to young men, in which he had enjoined them to always deal squarely and never on any account to abuse the competitor. Mr. Seabrook is, jointly with Mr. H. H. Holmes, the Electricity Sales Manager at Marylebone, responsible for an article in "Electrical Engineering" on "Electric Cooking;" and there is in it the same old shoppy and sloppy talk on the subject. Mr. Seabrook, as the instrument for the propagation of high moral commercial principles, does not seem quite the same person as the Mr. Seabrook who appends his name to the article before us. "Do not abuse your competitor." Excellent! This is what Mr. Seabrook, with his faithful Holmes backing him up, writes: "An indifferent cook with a gas-cooker becomes an excellent cook with an electric-stove and a good cook with a gas or coal cooker becomes—well, Lucullus himself could not find words to express it." Surely Mr. Seabrook does not admit himself inferior in respect of language to old-world Lucullus. Let it be written up on the walls of every electric station, "Do not abuse your competitors." By slipshod construction, Mr. Seabrook and his collaborator turn what was intended for abuse of gas into a reflection on electric cooking. "Fumes and smells caused by the products of combustion inseparable from *the use of any other method of cooking by electricity* are extremely unhealthy, depressing, and enervating. The health of the cook or mistress who does her own cooking is daily being undermined by these extremely unhealthy conditions." As the statement is constructed, it is made to appear that there is one method of cooking by electricity that emits no deleterious fumes, but all the other methods of cooking by electricity do. We had really encouraged the thought that Mr. Seabrook had of late risen above the absurdity of making himself the vehicle of such wretched slander ("abuse," if he prefers the term) as that intended in the statement referring to the health of mistress or cook being undermined. If he knows anything of the science of gas combustion, then he must be aware that the statement is untrue. If he does not know anything about gas combustion, then a sense of fairness ought to be sufficient to prevent such error. Healthy cooks and healthy mistresses with a lifelong experience of gas-stoves abound throughout the whole country. These people, reading what Mr. Seabrook says, would have quite as poor an opinion of his knowledge as he has of the capacity of the public for resisting belief in anything that the Electrical Engineer of St. Marylebone may choose to say. Then Mr. Seabrook and his co-author go on to talk of the greater amount of meat that is, according to their words, necessary if baking is done by any other than electrical methods. It would really be interesting to learn from Mr. Seabrook and Mr. Holmes whether they are prepared to prove that it is inevitable for a larger waste to take place in baking meat by any method in a gas-oven than in an electric-oven. Then we proceed to find some information in almost identical words as was found in the article by Mary Desbrisay in the "Daily Mail," and upon which comment was made last week. Now which is Mary—Seabrook or Holmes? Or which one coached the lady before writing her popular essay on electric cooking? Do not both answer at once, because it is apt to be confusing when two persons speak simultaneously.

We will only glance at one other article, and that on electric-radiators. The name of the author is not divulged; and probably for the very good reason that he did not desire to indirectly label himself with a self-depreciatory term. We see that "the gas-fire has been of considerable utility in its day, and it has its advocates still," which looks as though the writer of the article desires to make the "wider public" believe that the gas-fire is on its last legs, instead of acquainting them with what is the fact that there is such a boom in gas heating—a boom which commenced some three seasons ago—that the extensive works of certain of the manufacturers, running early and late, cannot keep pace with demand, and gas-fitters for connecting up gas-fires have been in huge request. The folly of electrical writers who affect to believe that what is actually in being is merely something visionary deserves all the ridicule and contempt that can be poured upon it. Here is another choice bit applied to the modern hygienic gas-fire: Where an electric radiator is in use, "the atmosphere remains pure, without any trace of the obnoxious smell of unconsumed or partially consumed gas." Are we to infer from this that, from a modern gas-fire, there arises an obnoxious smell of unconsumed or partially unconsumed gas? However, let us conclude this examination of curious statements with one more quotation: "While every recommendation of the gas-stove applies equally well to the electric heater, the electric-heater suffers from none of the detriments of the gas-stove." We may add that the electric heater does suffer from a shortness of many of the good points of gas-fires—and electricians know it.

There are still clouds hanging over the metallic filament lamp industry; and there are announcements that the associated lamp makers are meditating further litigation. These associated makers are the Osram Lamp Works, the British Thomson-Houston Company, and Messrs. Siemens Brothers and Co., who claim to be the owners of the fundamental patents relating to tungsten lamps. Various makers have been granted licences on terms to manufacture their own specialities; but there are independent manufacturers who refuse to recognize the lordship of the associated makers. The latter seem to be minded to bring the former into the fold; but the inclination of the one side is met by just as strong disinclination on the other side. So it looks like coming to the application of legal pressure. Then there are those gentlemen who dump metallic filament lamps of unknown parentage from foreign sources into this country; and their trafficking is now menaced. Their lamps are, for the most part, of an unwelcomed order to the electrical industry; for they are said to be cheap and

nasty. The electricity supply industry would back up the makers heart and soul in any steps they took to put an end to the trade in lamps of indifferent character. As "Meteor" of the "Electrical Times" says, "the present conditions call for quality maintenance in the interests of the user." We quite appreciate this. It is also said that price maintenance is in the interests of the makers. This, too, is unquestionably true; but what has the electricity supply industry to say to the latter part of this statement from the "Electrician:" "We are glad to see that the prices of lamps are being maintained, as at the present juncture it would be inexpedient to increase unduly the public demand." Of course, the whole weight of this statement depends on the extent of meaning attaching to "unduly."

At the very start of the "Point Fives" Club, we called attention to the fact that some of the few members were there under false pretences. Readers may be reminded that the "Point Fives" are electrical engineers who are supplying electrical energy at 0·5d. per unit for some domestic purpose. It was submitted by us months ago that most of the engineers who were charging 0·5d. per unit made it a condition precedent to the price coming into force that the consumer should pay a fixed charge. Two or three charge 0·5d. per unit for cooking and heating, and a higher price for lighting. But the others fall into the category of those who charge 0·5d. per unit, *plus* a substantial fixed charge. Therefore, there is no domestic consumer in the country who can say that the total of his account, divided by the number of units he consumes, shows that he has energy at 0·5d. per unit. The "Electrical Times" has only just discovered this vitiation of the title of the members to be known as "Point Fives," and has more than a column article on it. However, it is all in a piece with the pretence that bulks largely in the commercial policy of the electrical industry. The only thing the "Electrical Times" can suggest is that the members of the Club be divided into classes, and labelled accordingly, to indicate what they are really doing in the matter of charges.

Electric prepayment meters have not secured a large vogue. They are complicated in their organism; they are expensive; their life is short; and one electrical engineer, who had had experience of them in his district, once said in our presence that the constant trouble with them made him feel he would like to take a chopper—why some other article of equal destructive utility was not chosen he did not explain—and smash up the whole lot. We have not heard that he ever carried out the drastic clearance; but there has never been any boasting from his district as to the progress of the system. In "Installation Topics" article in the "Electrical Times," attention is called to an annoying defect of these meters—a defect not shared by prepayment gas-meters. As soon as the energy has passed for which payment has been made, the current is switched off with merciless suddenness, and the place is left in darkness, until a member of the household has found the necessary coin and transferred it to the place designed for its reception. The writer of "Installation Notes" suggests that someone would confer a boon upon the prepayment electrical business who succeeded in producing a meter that would gradually switch-off through a resistance, or cause the lights to flicker before final extinction. This would add to the cost of the meters; but the price charged for energy supplied through electric prepayment meters is on a scale that, it is thought, should suffice for bearing the expense of this additional outlay.

Sources of Water Power in Scotland.

In his inaugural address at the opening meeting of the Scottish local section of the Institution of Electrical Engineers, held in Glasgow on Tuesday last, Mr. William M'Whirter, the Chairman, spoke of the sources of water power in Scotland. From Fort William to Fort Augustus, he said, the chain of lochs forming the Caledonian Canal might be utilized in order to give a supply of power in excess of anything at present known. The level of Loch Lochy was 93 feet above the sea. The loch was 10 miles long, and of an average breadth of one mile. Its level might be raised to a height of 150 feet, which would double its storage capacity, and also connect it with Loch Arkaig. With the present knowledge of high-tension electrical power distribution, it would be possible to bring supplies of current from such a district to Glasgow and the West of Scotland—the distance being not more than 100 miles, and the route nearly all through country where there would be no difficulty in obtaining the necessary wayleaves. Loch Ness was available for similar purposes.

At a meeting of the Liverpool University Chemical Society on Thursday last, a paper was read by Mr. J. C. Cunningham, on "The Constitution of Water." The author stated that it had become necessary for the old idea that the formula of the molecule of water was H_2O to be discarded, as it was obvious that it did not represent the constitution of water. The deductions of Röntgen and others led to the conclusion that it was $(H_2O)_3$.

We have received from Messrs. Emmott and Co., Limited, of Manchester and London, the "Mechanical World" Pocket Diary and Year Book for 1913. This is the twenty-sixth issue, and it embodies many new features compared with its predecessors. The section on "The Gas-Engine" has been re-written, and now includes additional data and tables; while the work generally has been subjected to a thorough revision. The book (price 6d. net) is a useful collection of engineering notes, rules, &c.

WATER LEGISLATION FOR 1912.

[Third Article.]

The following are the remaining Acts of local authorities containing provisions in regard to water supply.

The Act obtained by the Ivybridge Urban District Council confirms the construction and use of the existing water-works, comprising an intake on the River Erme, a supply-pipe from it to a reservoir, and a line of pipes from the latter to a defined point in the public road. The Council have also been authorized to construct a reservoir on the Butter Brook, two aqueducts, and an approach road. Ample provision is made for furnishing compensation water. The limits of supply are the district of the Council; and the rates to be charged are the usual 8s. 8d. where the rateable value of the premises does not exceed £5 per annum, and 10 per cent. on the rateable value where it is higher than this. In the case of meter supplies, the charge is not to exceed 1s. 6d. per 1000 gallons. The Council may enter into contracts for selling water in bulk. For the purchase of lands and easements for or in connection with the existing works and the construction of the reservoir, they may borrow £6680; for the other works, £1420; and, of course, the amount necessary to defray the expenses of obtaining the Act. The repayment of the two amounts specified may be spread over sixty and fifty years respectively from the date or dates of borrowing; and five years from the passing of the Act are allowed in the case of the last amount. [*Parliamentary Agents: Messrs. Torr and Co.*]

The Keighley Corporation are empowered to construct additional water-works and abandon a reservoir and a conduit authorized by their Acts of 1869 and 1898. The new works comprise an enlargement of the Lower Laithe reservoir sanctioned by the first-named Act, a service reservoir in the parish of Oakworth, three aqueducts, and a road diversion; and ten years are allowed within which to complete them. A sum of £195,200 may be borrowed for carrying out the reservoirs, making the road diversion, constructing filter-beds, and laying mains, to be repaid within sixty years; and £13,550 for the construction of the aqueducts, repayable within forty-five years. [*Parliamentary Agents: Messrs. Sharpe, Pritchard, and Co.*]

The Llanelly Rural District Council have obtained authority to take a supply of water from the River Sawdde, in the county of Carmarthen, and construct new works. These comprise an embankment, an intake weir, a catchwater, two reservoirs, three lines of pipes, and a communication road; and a period of ten years is granted for carrying them out. Until the completion of the embankment, the Council may take from the Sawdde any water they require, subject to certain restrictions; and when it is finished they are to deliver into the river, at a point above the intake weir, not less than 680,000 gallons per day in a continuous flow, measured by a gauge which they are to provide. In the Bill, the compensation water was put at 500,000 gallons. The limits of supply are to be the Rural Council's district, with the exception of a portion defined; and the rates to be charged are 8s. 8d. where the gross estimated rental of the premises does not exceed £5, and 10 per cent. per annum where it is above this figure, with extras. The Council are authorized to borrow for the purchase of lands and easements, the construction of works, &c., £179,423; and for paying the costs and expenses of the Act the sum requisite for the purpose. Sixty years from the date or dates of borrowing, and the usual five years from the passing of the Act, are the periods specified for the repayment of the loans. In the Bill, the Rural District Council asked to be empowered to purchase, at a price to be agreed upon or settled by arbitration, such portion of the water works and plant of the Urban Council as is situated within their area; but there is nothing in the Act to sanction this. [*Parliamentary Agents: Messrs. Torr and Co.*]

The Scunthorpe Urban District Water Act gives the Council authority to construct works, acquire additional lands, and make further provision for the supply of water in their district. The works consist of a pumping-station to be situated to the west of the existing station and works of the Council; and an aqueduct or pipe-line commencing there, and terminating by a junction with the present main at a point defined. Five years are allowed for the completion of these works, which is just half the time named in the Bill. Authority is given to raise not exceeding £4600 for the purchase of land and the construction of the works specified, to be repaid within fifty years; and £5300 for a new service-tank, a rising main, and mains and pipes for the supply of the urban district of Roxby-cum-Risby, to be repaid within forty-five years. The limits of supply are extended to include the place just named. [*Parliamentary Agents: Messrs. Sherwood and Co.*]

Further powers are granted to the Swansea Corporation in regard (*inter alia*) to their water undertaking; and they are set forth in one part out of thirteen in a voluminous Bill. The first provision concerns the compensation water to be furnished to the Blaenant Ddu Brook; and under it the Corporation will be able to supply this water from any of their existing reservoirs. They are given authority to lay water-pipes in streets not dedicated to public use, fix meters and similar appliances for the detection of waste, and make bye-laws with a like object. One section of the Act relieves the Corporation from the obligation to supply with water otherwise than by measure any building used by an occupier as a dwelling-house of which part is utilized by him for any trade or manufacturing purpose for which water is required. The price

to be charged for water supplied by measure, except for the use of vessels, is not to exceed 1s. 6d. per 1000 gallons. No money was required for any of the purposes specified. [*Parliamentary Agents: Messrs. Sharpe, Pritchard, and Co.*]

The Tavistock Urban District Council are authorized to acquire by agreement the water undertaking from the Duke of Bedford, and to make further provision in regard to the supply of water. The price is to be determined by a single arbitrator (Mr. A. J. Ram, K.C.); and the purchase is to be completed on the quarter-day that follows next after the expiration of six months from the passing of the Act. The limits of supply are the parishes of Tavistock Hamlets and Whitchurch, in the county of Devon. Where the premises supplied with water are situated within the district, and are served solely by gravitation, the charge is to be 9d. in the pound on the rateable value; in the case of all other premises, it is to be 1s., with a minimum of 5s. in respect of any one year, compared with 8s. 8d. in the Bill. For a supply by meter, the maximum charge is to be 1s. per 1000 gallons, with a minimum not exceeding 10s. per quarter. Provision is made for the supply of water in bulk. Authority is given to borrow the money necessary for the acquisition of the water undertaking and the payment of the costs and expenses incurred in connection therewith; and the former is to be repaid within fifty years from the date or dates of borrowing. [*Parliamentary Agents: Messrs. Baker and Co.*]

An extension of time for the construction of the works authorized by the Ystradfellte Water Act of 1902 is granted by the Act obtained by the Neath Rural District Council, as well as further powers in regard to their water undertaking. The extension sanctioned is five years from the passing of the Act; and the Council have permission to take water from the River Tringarth until the expiration of this time or the completion and filling of the Ystradfellte reservoir, whichever shall first happen. The Council may borrow £144,000 in connection with the construction and completion of the works sanctioned by the Act of 1902 and the present Act; and it is to be repaid within sixty years from the date or dates of borrowing. The price to be charged for water supplied by measure is not to exceed 2s. per 1000 gallons. [*Parliamentary Agents: Messrs. Sharpe, Pritchard, and Co.*]

TAR IN RELATION TO ROAD CONSTRUCTION.*

The little work of 137 pages on "Modern Road Construction," which Mr. Francis Wood, the Borough Surveyor of Fulham, has found time to prepare, should prove very useful to the less experienced road surveyors and their assistants and pupils. It brings together much valuable matter in a small compass.

It is mainly in relation to the author's observations on the use of tar, pitch, and bitumen in road construction and preservation that we propose to offer some comments. As regards these materials, it seems clear that his practical experience has been mainly confined to suburban roads, where the traffic conditions differ widely from those of trunk roads through country districts. According to him, any increase on a grade of 1 in 22 should be adopted only when circumstances absolutely prevent the more favourable grade. This is a counsel of perfection which would entail, if adopted, an enormous capital outlay in the case of almost every one of the roads radiating from London to south coast resorts. If there were to be an immense increase in the amount of horse-drawn traffic, the proposition might be supported out of consideration for the horse and in order to reduce the loss of time through halts for resting. But clearly all the more serious traction on our roads will very soon be wholly transferred to the self-propelled vehicle. Assuming that the road engineer is equal to the task of constructing a road which is suitable for and will bear such traffic, it becomes a question on roads crossing say the North or the South Downs, whether it is more economical in respect of power consumption, wear and tear, and expenditure of time to rise 350 feet by an average grade of 1 in 15 extending over a mile, or by an average grade of 1 in 22 extending over nearly a mile and a half. The relative economy of the two grades for up-going traffic must also not be considered apart from the relative effects of the two grades on the wear and tear of tyres and road surface, and on the expenditure of time for down-going traffic. We fancy that with the older modes of road surfacing, and with under-horsed or under-powered vehicles, a good argument might have been sustained in favour of a grade of 1 in 22 not being exceeded; but at the present day all this has been changed. The road engineer who pretended that he could not provide a smooth and durable surface on a grade of 1 in 15 would merely display ignorance of modern methods of utilizing tar in road construction and maintenance. Having regard to the proved success of these methods on such grades in Kent and elsewhere, it would be unreasonable to lengthen a road by nearly half as much again, in order that a hill might be traversed at the gentler grade of 1 in 22. Obviously the road engineer, in laying out a trunk road at the present day, must fix upon some grade which should not anywhere be exceeded; but in the country, where there are any considerable elevations, this grade need not be less than about 1 in 12. Tar and pitch will enable the engineer to provide an even surface on such a grade, which will be durable under heavy and fast motor-traffic, and will not produce either mud in winter or dust in summer.

We think that Mr. Wood has not realized sufficiently the change which self-propelled vehicles on the one hand, and tar for road construction on the other hand, have wrought in the conditions of transit and transport on the main roads in country districts. The volume and weight of traffic have increased enormously, and there is a far greater reserve of propelling power, so that gradients, to avoid which detours were frequently made in the past, are now surmounted with ease even by heavily laden vehicles. Concurrently, however, the road engineer has learnt to use tar, &c., in road construction and maintenance, with the result that the increased traffic is borne on better roads at very little greater expenditure on upkeep. The full advantages derivable from tar are not realized on the suburban or urban roads in regard to which Mr. Wood quotes his experiences. The latter are, as a whole, very favourable to tar, but on such roads more costly materials than tar and pitch become economically available, whereas the majority of them are out of the question for country districts. It is in these districts that tar and pitch, applied under the guidance of men well versed in the effect of variations in their composition on their physical characteristics, hold an unassailable position.

Mr. Wood naturally does not pretend to write as an authority on tar; and we find him by a curious confusion of terminology speaking of "carburetted oil-gas tar"—an almost unimaginable preparation. He does not, however, appear to have realized how closely the pitch from oil-tar or carburetted water-gas tar often resembles some of the highest qualities of natural bitumen. But we are glad to see that he does not support some exploiters of asphalt in denying the right of the bituminous matter in tar to be classed as "bitumen." He holds, however, curious views as to naphthalene, which he regards as having a great affinity for moisture. For instance, he says that "dehydrated tar—*i.e.*, the tar from which have been removed the water, naphtha, phenols, &c.—still retains the naphthalene, *the substance which absorbs moisture*." The words which we have italicized show a strange ignorance of the insolubility of naphthalene in water and of the non-absorbability of water by naphthalene. It is doubtless from erroneous ideas such as this that many road surveyors have been led to mistrust tar altogether, or to buy only on weird specifications. Naphthalene may be undesirable in very large proportion in tar for road use, but the reasons why it may be so are not indicated by Mr. Wood, though they are pretty obvious to gas engineers and tar distillers.

Mr. Wood appears to us also to have failed to grasp the action of the oils in tar and many preparations of tar. He does not realize that light oils may be used as a vehicle to secure good penetration of a road surface by the pitchy constituents. We believe that many successful preparations of tar for road use, including Clare's Compound which was awarded a hundred-guinea trophy in an open competition a few years ago, contain considerable proportions of fairly volatile oils, which serve as a vehicle and render the preparation sufficiently fluid for it to be applied to road surfaces at a lower temperature than ordinary dehydrated tar. There is no doubt that much dehydrated tar of the heavier grades is damaged by local overheating or burning by the road men in their efforts to heat it until it is sufficiently fluid to spread and penetrate well. Failures of the tarred surfaces in such circumstances are wrongly attributed by the road surveyor to the naphthalene or free carbon in the tar, instead of to the improper treatment which his minions have bestowed upon it. For these reasons we think road surveyors who do not, by the use of metal-cased thermometers such as those supplied for the purpose by Mr. John Hutchinson, and by adequate supervision, take steps to prevent heavy tar being spoilt in the boilers or "kettles" at the roadside, will do better to use lighter grades. On this account crude tar will often give better results for the surface painting of roads than a thick dehydrated tar.

We have said enough to indicate that Mr. Wood must not be regarded as a wholly trustworthy guide, in so far as the application of bituminous materials to road construction and maintenance is concerned. But he has produced a handy little work which gives a great deal of valuable information, culled mainly from his experience as Borough Surveyor in an important London suburb.

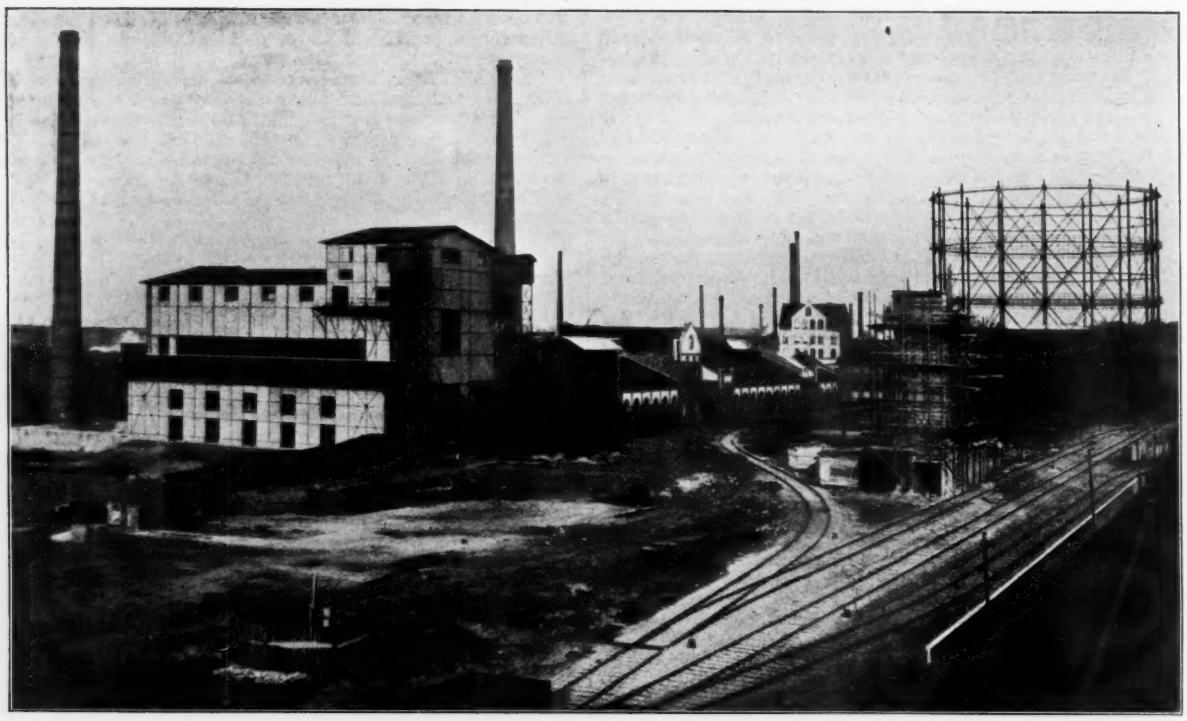
* "Modern Road Construction," A Practical Treatise for the Use of Engineers, Students, Members of Local Authorities, &c. By Francis Wood, M.Inst.C.E., F.G.S., Borough Surveyor of Fulham; late Borough Engineer, Bacup, Lancs.; Author of "Practical Sanitary Engineering." With 25 Illustrations, a Coloured Map, and a Chart. London: Charles Griffin and Co., Limited; 1912.

Selenium as a Standard of Light.—According to a short communication by Dr. L. K. Hirshberg, of the Johns Hopkins University, of Baltimore, to the "American Gaslight Journal," Dr. A. H. Pfund, the Associate Professor of Physics in the University, has devised an instrument for measuring light by means of selenium. If the energy carried by an intense beam of light is to be exactly measured, a small needle, much like a compass arrangement, is deflected from its resting position a certain distance to the right or left. He, however, advises great caution in using the metal as a standard for measuring white light. Assuming that it combines the effects of the different colours, according to its sensitiveness to each, the needle deflections on the measured scale will not vary according to the strength of the white light, but to some value determined by an average of the different colours.

THE NEW GAS-WORKS AT LINDEN (HANOVER).*

By William Anderson, of the Imperial Continental Gas Association, Hanover.

[A Paper read at the Meeting of the Association of Gas Engineers of Lower Saxony.]



General View of the Works, Facing East.

The two neighbouring towns of Hanover and Linden, which are separated from one another by the River Leine, have been, up to the present time, supplied with gas from a single works, which were started in the Glockseestrasse in 1825. Although the works were kept up to date and were capable of being enlarged sufficiently to meet all requirements for some time to come, the Imperial Continental Gas Association deemed it advisable to build new works to supply Linden and all the districts situated on the west bank of the Leine. These comprise the suburbs of Limmer, Badenstedt, Davenstedt, and Bornum, as well as the neighbouring communities of Ricklingen, Empelde, Velber, Ahlem, Letter, and Seelze, with a total population of about 90,000. The yearly gas consumption is about 176,500,000 cubic feet, or nearly 2000 cubic feet per head—a particularly low average, but due to the fact that a large percentage of the population consists of the agricultural or labouring classes.

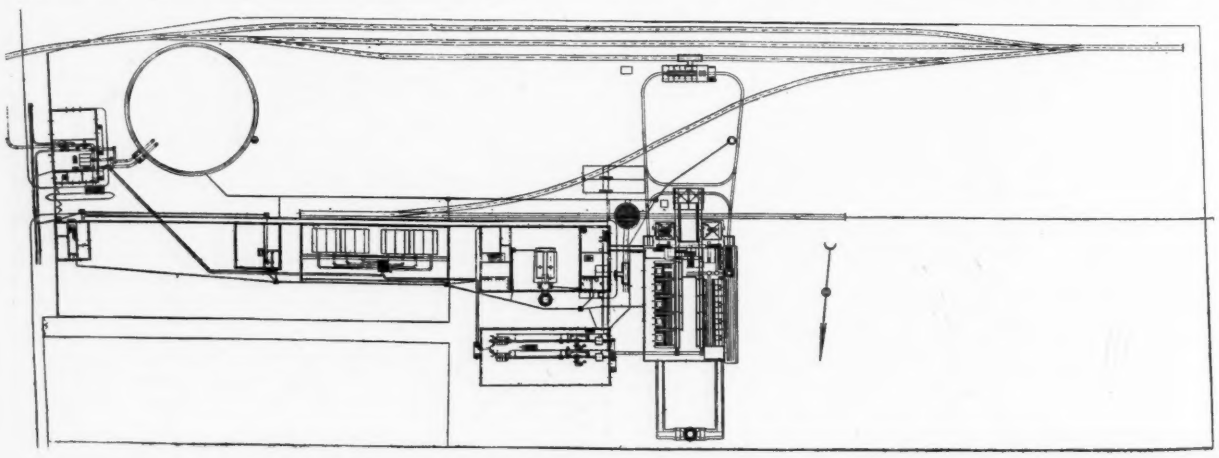
In the year 1909, between 10 and 11 acres of land were bought from the town of Linden for the new works. The land was very well situated near a new road, and was already provided with a siding from the railway. There is also the possibility of being able to connect up later to the Linden harbour of the Rhein-Leine Canal. The shape of the land (a long rectangle) was suitable for the building of gas-works, as the positions of the railway siding and the future canal arm relatively to one another are very convenient; and as regards centrality, the site is all that could be desired. The problem presented to me was to plan the works for a make of 40,000 cubic metres [about 1,400,000 cubic feet] per twenty-four hours, capable of being increased six-fold. The site is roughly 393 yards long and 142 yards broad.

Railway Siding.

The siding runs from the Linden Goods Station to the southern side of the works. It consists of three main parallel lines running the whole length of the ground, and one line connecting the arrival rails with the branch lines leading to the retort-house, boiler-house, purifier-house, and coal-store. The latter is situated in the space between the three main lines and the branch line. But as it is at present impossible to tell the exact position which the Canal—only lately begun—will finally occupy, it was impossible to draw up plans for the coal-handling machinery; and the necessary work will for the present have to be done by hand. The trucks are moved on the lines by Windoff and Co.'s special system of electrically driven capstans and rollers with metal ropes. Two capstans have been fitted—one on the main lines, and the other on the retort-house line; and by arranging the rollers in suitable places, the trucks can be moved in any desired direction.

The retort-house line leads to the coal-breaker at the top end of the house, and also to the coal-store. The coal can be unloaded

* A short account of the proceedings at the ceremony of opening the works referred to appeared in the "Journal" for Nov. 5, p. 430.



Ground Plan of the Works.

directly into the breaker. A turntable between the retort-house and boiler-house completes the connection with the departure line for tar and ammoniacal liquor. Boiler-fuel and purifying-material can be directly unloaded at the places where they are required. Later on, turntables can be laid at each end of the purifier-house, in order to facilitate the supplying of the purifiers with material.

Retort-House.

At present, only one-half of the first retort-house has been built, with ten furnaces of eighteen vertical retorts each. The iron-work was supplied by the Vertikal-Ofenbaugesellschaft, and is of their usual type. The retorts are also of the usual type, except that, instead of the ordinary long gas outlets, each row of retorts has been fitted with short horizontal outlet pipes, which dip direct into the hydraulic mains. As eighteen retorts to each furnace seemed rather a lot, one furnace was divided into two parts, of nine and six retorts respectively, by a division wall, and the building of two separate producers—this making it easier to cope with variations in the consumption. To enlarge the retort-house, it will only be necessary to move the back-wall as far as the northern boundary behind the chimney (which is large enough for the complete plant), and then finish the house and the furnaces.

At the top end of the house are the coal-breakers and elevators. The latter, which can deal with 30 tons each per hour, raise the coal into bunkers, of 10 tons capacity each, and about 63 feet above the ground. From these, it is conveyed by tipping-trucks to the separate bunkers placed above the retorts. All the bunkers together hold 412 tons, which would suffice for 48 hours' full working.

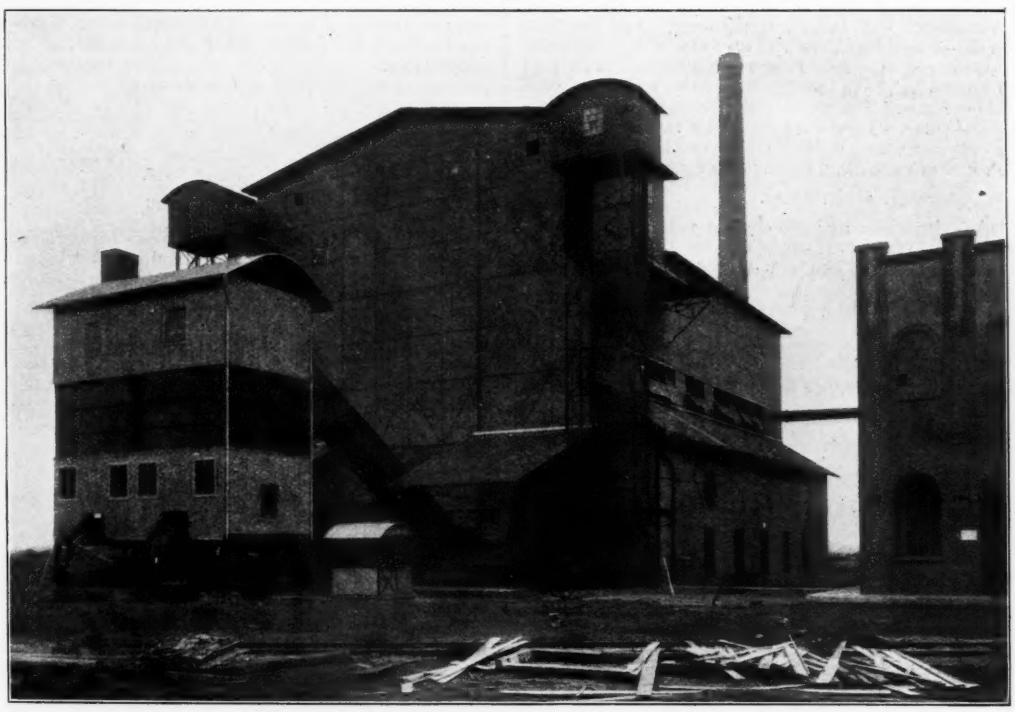
Right and left of the coal-breakers are two electric lifts, which, in the ordinary course, raise the coke for the producers. In the event of the coal-elevators requiring repairs, however, these lifts would be used for raising coal in tip-trucks, which would shoot it straight into the bunkers above the retorts.

The coke is quenched in electrically driven transport-troughs under the retorts, and so conveyed to the coke-bunker, which can hold 85 tons—at present the output of about 16 hours working. Under the bunker is a screen, which separates the large coke from the small; the former being sent straight away, and the latter being conveyed in tipping-trucks, on a small branch rail, to the coke-screening plant, where it is sorted according to size and stored. The large pieces of coke can also be broken up if necessary. It is intended to leave all the coke produced during the night in the night bunker; the other operations only taking place by day.

The screening plant is fitted with an electrically driven lift for raising the tipping trucks to the screens, the breaker, or the bunker. The coke-shoots are so arranged that the coke can be filled direct into railway trucks or dealers' carts. Near by is a weighbridge for the former; while the latter are weighed at the entrance to the works.

Boiler House and Overhead Water-Tank.

The boiler-house has two wings, on the left the pump-room and overhead tank, on the right the workmen's quarters. The boiler-room is arranged to take six boilers. At present there are only two twin-flue boilers, made by the Hanover firm of Knoevenagel. The chimney will suffice for all six boilers.



Exterior View of the Retort-House and Coke-Screening Plant.

In the room under the tank are all the pumps for ammoniacal liquor, tar, and water, as well as the feeding pumps for the boilers. There is also a small electric power station, consisting of transformers for the high-power current drawn from the municipal works, and a direct connected dynamo with steam-engine, capable of generating 50 K.W.H., in reserve. The town supply of current is at a voltage of 6000, and is transformed to 220 volts. On the first floor of the pump-room there are two tanks, each holding 60 cubic metres [about 2120 cubic feet] of ammonia water and tar; and above these is the water tank of 120 cubic metres capacity, forming at the same time the roof of this wing of the building. In shape, it is parabolic, and is fastened to the walls, which are strengthened at the points of contact by means of columns.

Underground Ammonia and Tar Tanks.

These are made of reinforced concrete. They are just over 3 feet deep, and lie 2½ feet below the surface of the yard in front of the retort and boiler houses. Together they form a rectangular box, about 62 feet by 28 feet, divided into two symmetrical halves by a longitudinal wall. Each of these halves again falls into three divisions. The middle ones are separating tanks; and the outside ones are, respectively, for tar and ammoniacal liquor. The overflow-pipes from the middle tank to the tar tank on the one side, and the ammonia tank on the other, can be closed from above, so that they can be worked alternately. Two pumps of the plunger type draw the liquids from the tanks and force them to the overhead tanks, whence they can be sent away by rail.

All six tanks are accessible by means of man-holes, covered with cast-iron lids. Together their capacity is about 13,500 cubic feet.

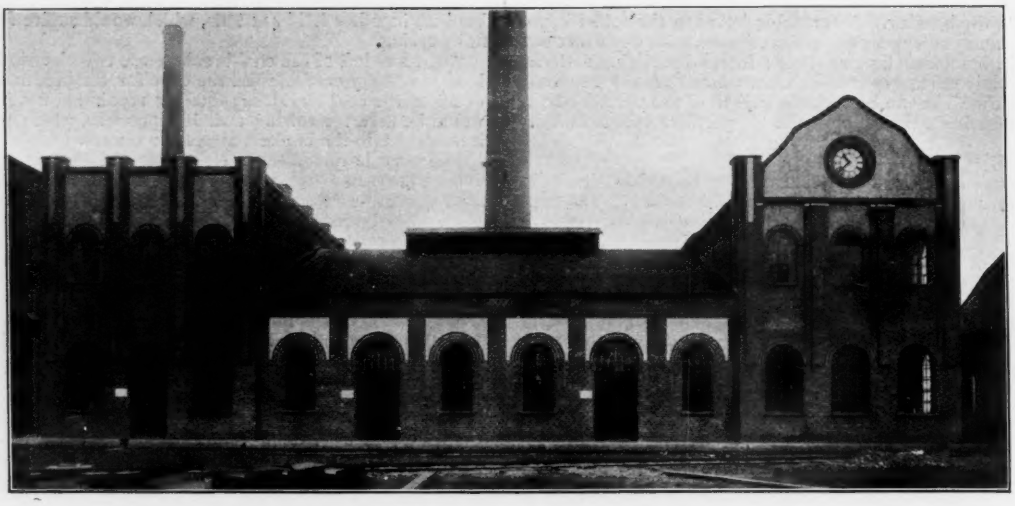
Exhausters, Washers, &c.

The room for the exhausters, washers, &c., behind the boiler-house is at present large enough to take three sets of apparatus, each capable of dealing with 40,000 cubic metres daily [about 1,400,000 cubic feet]. But so far, only two sets are built, and space left for the third. In the second part of the house, which can be added later, three sets could be put up for 80,000 cubic metres each daily. The sets consist of water cooler, exhauster with bye-pass regulator, tar-separator, and ammonia-washer. These appliances, with the necessary connections, were supplied by the "B.A.M.A.G." Company, with the exception of the water-cooler, which was constructed by the firm of Conrad Engelke after our own designs.

So far naphthalene and cyanogen washers have not been included, as it is asserted that these are unnecessary with vertical retorts. But there is space enough, in case the need for them is felt later. All connections and bye-passes are in a deep and spacious cellar under the building, where they are at all times easily accessible. To extend this house, it will only be necessary to move back the back wall, which is iron frame-work, and then complete the side walls and the roof. The front face is permanent work.

Purifier-House.

The purifier-house is in a straight line with the boiler-house.



Boiler-House, Tar, Liquor, and Water Tanks, Electric Power Station, Pump Room, Workmen's Quarters, and Laboratory.

Extensions can be carried out here exactly as in the washer-house, as here also the back wall is iron frame-work. The purifiers, which are on the ground-level, are also made for a daily capacity of 40,000 cubic metres. The four boxes, which have each an area of about 650 square feet, have four layers of grids, and are always filled with oxide of iron. The order of the boxes is changed by a Weck's regulator-valve. They were made by the Dampfkessel- und Gasometerfabrik vorm. Wilke, of Brunswick; the regulator and the pipe-services were fitted by our own men.

Gasholder.

The holder has three lifts, and will contain 30,000 cubic metres [about 1,059,600 cubic feet]. It works in a steel tank of 126 feet diameter, and 33 feet deep. The total height of the holder when full is about 40 metres [130 feet]. The foundations for the tank were our own work; and the holder was made and erected by Carl Francke, of Bremen.

Meter and Governor House.

This is situated at the entrance to the works, and is connected with the porter's and weigh-master's lodge. One-half of the house is also used as a store. At present there is room for two station meters, each capable of passing 1750 cubic metres [61,800 cubic feet] of gas per hour, and two governors. So far, however, only one meter has been erected. But later on, if necessary, room can be found for four, by using the other half of the house as a meter-room.

Offices.

These are on the right of the main entrance, and contain a room for the Engineer-in-Charge, an office, and draughtsman's room, &c., on the ground floor, and a spacious dwelling for the foreman of the works on the first floor.

Workshops.

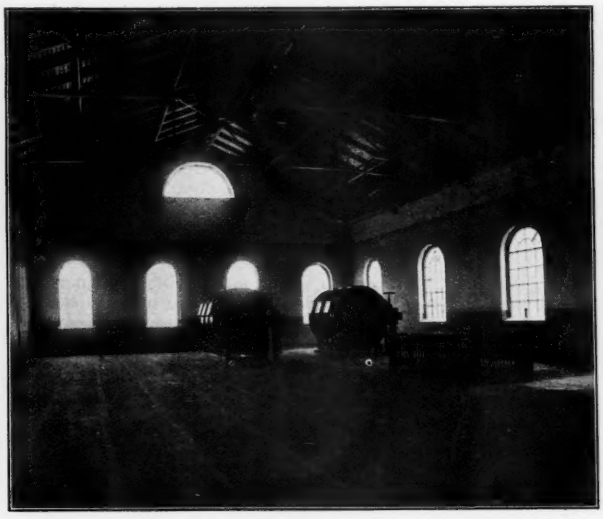
Between the purifier-house and the entrance are the workshops, consisting of a carpenters' shop, smithy, and joiners' shop—all well fitted to deal with necessary repairs on the works.

Workmen's Quarters.

In the right wing of the boiler-house the personal comfort of the men is catered for. The dressing-room contains a cupboard for each man; in the bath-room are showers and hand-basins, with hot and cold water; and spacious, light, and comfortable mess-rooms are also provided. On the first floor are special rooms for the foremen, and also the laboratory.

Interior of the Retort-House—Showing the Dessau Verticals.

Exhausters, Condensers, and Tar-Separators.



Ammonia Scrubber-Washers.

GENERAL.

In order to make readily accessible all the pipes, &c., on the works, a channel has been cut the whole length of the site, to contain them. It is spacious, and merely covered with cement flags, which can be easily lifted when repairs or extensions are required; while at the same time they serve as a pavement. Further, I should like to mention that all foundations for the buildings and chimneys, as well as all bricklaying, have been carried out by us, with the exception of the office. Likewise our own men laid all the principal pipe-services except the connections in the washer-house and station-meter room.

The first sod of the site was cut on May 6, 1911, and with the exception of the gasholder, the works were completed by Aug. 1 of this year. It is a source of great satisfaction to me to be able to state that, except for minor injuries, we have had no accidents at all, which is high praise for the careful way in which all the building operations were carried on.

SOUTHERN DISTRICT GAS ASSOCIATION.

Autumn Meeting.

The Autumn Meeting of the Association (which was very well attended) was held at the Hotel Cecil, Strand, last Thursday—the PRESIDENT (Mr. B. R. Green, of Mitcham) in the chair.

ELECTION OF OFFICE-BEARERS.

After the minutes of the last meeting had been taken as read,

The PRESIDENT said the next item on the *agenda* was the election of a President for the ensuing year. This was an indication that he had reached a certain stage or period in his office as President. He asked Mr. H. E. Jones to make a proposition.

Mr. H. E. JONES remarked that he had just had a great honour thrust upon him. It was a matter of regret to him that he did not get more often to these meetings. He had, however, come that afternoon with the object of being what he called "among some of his boys." He did not expect that one of them was to be put forward immediately, or that he would be called upon to help this putting forward. But as he had done his best to school this "boy" as a good gas engineer, it was with very great pleasure that he responded to the President's request to propose Mr. H. O. Carr (of Wandsworth) as President for next year. He was sure Mr. Carr would protect the Association's interests if they elected him. Mr. Green had been a very good President, and he hoped he would stick to the Association. With regard to Mr. Carr, he became his (Mr. Jones's) pupil he did not know how many years ago. His father, who was the distinguished Engineer to the London Docks, was a very old friend of his, and asked him one day if he had room for a young fellow. He replied that he had plenty of room for a young chap who meant to work, and he would take him for a month or two on trial. At the end of two months, he had found that the young fellow was evidently determined to work, and that he was just the sort of chap he (the speaker) liked. He could not put it stronger than that. His experience of Mr. Carr through all these years made him say the same thing to-day. He was energetic in the extreme, and, like Mr. Green, amiable in disposition and very pleasant to work with. He had done great service to him (Mr. Jones) personally, as well as to the Company with whom he had been for some years past.

Mr. R. BEYNON (Torquay), in seconding the proposition, remarked that he had not known Mr. Carr very long; but from what he had seen of him, he felt certain that they would have a most energetic and genial President.

The proposition having been carried with applause,

Mr. CARR thanked the members for the honour they had done him. He said that in filling the responsible position to which they had elected him, he would always have before him the example of the many worthy Presidents who had gone through the office. He was exceedingly gratified to hear the very kind remarks Mr. Jones had just made. He was proud to be one of Mr. Jones's "boys." His school was a well-known one, and the motto of it was "Work." He was quite sure that all his pupils appreciated the amount of interest he always took in their welfare. He was very sympathetic, and very generous in his dealings with them.

Mr. DOUGLAS H. HELPS (Reading) proposed the election of Mr. Thomas Glover, of Norwich, as Vice-President. It seemed rather strange, he said, that at this stage they should be asking Mr. Glover to accept the post; but he was a comparatively new member of their Association. They had been very fortunate (seeing that he came from Norwich) in having him as a member; and they would be still more fortunate in securing him for Vice-President.

Mr. F. W. CROSS (Lea Bridge) seconded the resolution, which was cordially agreed to.

Mr. GLOVER, in returning thanks, remarked that Norwich was not exactly in the Southern Counties; but as London was one of the easiest places to get to, and as the technical fare was usually of a high order in the Southern Association, he had derived great pleasure from being a member and attending the meetings. He joined when the naphthalene controversy was warm; and he was expected to do a little to help to clear the matter up. He did a little, and was only sorry he had not been able to do more for the Association. However, he would do what he could in the next year and the succeeding twelve months.

The PRESIDENT said the next item was the election of members of the Committee. Rule 5 provided that two members of Committee should retire annually in rotation, and be ineligible for nomination in the following year. In this instance, there were three vacancies on the Committee—Mr. Glover's appointment as Vice-President making the third. The other two members retiring were Mr. J. W. Helps and Mr. A. F. Browne.

Mr. D. IRVING (Bristol) proposed the names of Mr. W. Doig Gibb, Mr. A. Caddick, and Mr. W. N. Westlake. In doing so, he said he desired to express the sympathy of the members with Mr. Helps in his ill-health, and the hope that he would soon be restored, and that they would have the pleasure of seeing him at the meetings again.

Mr. H. BUCKLEY (Windsor) seconded the proposition, and it was carried.

The PRESIDENT asked whether it was the wish of the members that what Mr. Irving had said with regard to Mr. Helps should be conveyed to him.

The members expressed cordial assent to this.

On the motion of Mr. W. B. RANDALL (Waltham Cross), seconded by Mr. J. H. CORNISH (Bridgwater), Mr. J. L. Chapman and Mr. A. Dougall were next re-appointed Auditors.

The PRESIDENT, proposing the re-election of Mr. W. E. Price as Hon. Secretary, said he felt he owed much to that gentleman

during the period he had served as President of the Association. It was only one who was placed in the position of President who could realize how much an Hon. Secretary could do.

The resolution was seconded by Mr. A. CADDICK (Croydon), and cordially agreed to; and Mr. PRICE duly acknowledged his re-appointment.

NEW MEMBERS.

The following new members were then elected: Mr. James Armstrong, of Ilfracombe; Mr. Harold E. Copp, of West Bromwich; and Mr. Albert Stokes, of the South Metropolitan Gas Company.

REPORT OF THE COMMERCIAL SECTION.

The PRESIDENT, referring to the report of the Commercial Section, said this was the first occasion on which the report of the proceedings of the section had been published. As a matter of fact, it was the third report which had been issued by the Committee; but the previous two had not been served up in the complete manner of the one now submitted. Mr. Price was the Chairman of the Commercial Section; and he was going to ask him to submit the report, and give them the details of it.

Mr. W. E. PRICE (Hampton Wick) said he thought that, for the welfare of the Association, and also for the benefit of the Commercial Section, the Association should take interest, and if possible more interest, in the work of the section. Those of them who had been in the Commercial Section, knew the extreme value it was to them in many ways. The number of members of the Commercial Section was 53; while, speaking in round figures, the undertakings represented in the Southern District Association numbered about 150. Thus only about one-third of the members of the Association had joined the Commercial Section; and he felt satisfied that if those members who had not joined were to come in and see what it was like, even if some might think they would not get the fullest benefit from the information circulated periodically as to the prices of residual products, they would find it beneficial to join, even to attend the meetings and take part in the matters discussed there. During the past year, seven general meetings had been held. In the summer there were no meetings; but at other times of the year they took place monthly. The report referred to the coal strike, and to the dock strike which came immediately on the top of it, with the result that many gas companies were prevented from receiving a supply of coal for a period extending to, in some cases, twelve weeks. The position was considered at two meetings, and much useful information disseminated. The question of a strike clause which would afford gas companies necessary protection, and which would be at the same time acceptable to suppliers, was discussed and referred to the Council of the Institution of Gas Engineers; and, as a consequence, a standard strike clause was adopted by the Institution, which had been found acceptable to the suppliers of coal. This was another branch in which the Commercial Section was able to make itself useful; and he thought no one could deny that what it had done in different ways was of the greatest benefit to the industry. The meetings and the issue of the periodical returns had enabled the subscribing undertakings to obtain the full benefit of the condition of the coke market; and the same remark applied to tar. The question of the terms of residuals contracts and strike clauses was also discussed, and the subject of National Health Insurance dealt with. In connection with the last-named matter, it was pointed out that many employees in a gas company were, for practical purposes, there for life, and it seemed rather absurd that they should for the rest of their lives pay under the Unemployment Section, when in all probability they would never have to make use of the section. Then the Alkali Manufacturers' chemical clause was discussed, and the President of the Institution of Gas Engineers attended a meeting of the Commercial Section. Many other subjects were also considered; so that he thought they would see the Commercial Section was doing good work. All they wanted was a fuller measure of support from the members of the Association.

The PRESIDENT moved the adoption of the report; and this was seconded by Mr. J. PATERSON (Cheltenham), and agreed to.

THE PAPERS.—A NEW DEPARTURE.

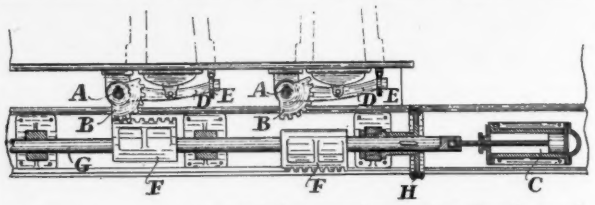
The PRESIDENT remarked that, before they took the papers, he would like to say a word about their not being read. The Committee had for some time had this matter under consideration, and they decided to try an experiment. In this respect, the Southern District Association were pioneers. He believed, however, the Institution of Gas Engineers were thinking over the matter, and there was a probability of their adopting the same procedure. The idea was that, by the authors summarizing their papers (which had been previously distributed), and not reading them, a good deal more time would be available for discussion; and when there were papers such as they had got that day, about questions upon which there was likely to be considerable discussion, it would be a great advantage to have an extended time for this purpose. But it was only an experiment; and its continuance depended upon the success with which it met that afternoon. If it was not successful, they would probably revert to the old arrangement of having the papers read by the contributors. The communications about to be submitted to them were excellent ones; and he hoped those present had had an opportunity of studying them, and that good discussions would result.

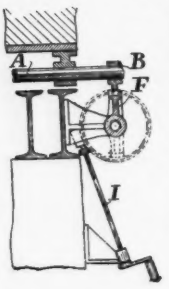
The titles of the three papers were as follows (they will be found, with reports of the discussions, on the pages given after them in parentheses): "The Use of Reinforced Concrete in Gas-Works," by Mr. J. FISHER, of Tottenham (pp. 583-88). "Retort-House Furnace Charging, and Other Details," by Mr. G. M. GILL, of the Commercial Gas Company (pp. 591-94). "Pipe-Jointing, and a Few Notes on Mainlaying," by Mr. W. G. HEAD, of the South Metropolitan Gas Company (pp. 595-600).

Before the meeting separated, the authors were heartily thanked, on the proposition of Mr. H. C. HEAD (Winchester), seconded by Mr. W. H. BENNETT (Redhill).

OPENING AND CLOSING VERTICAL RETORT LIDS.

In working vertical retorts it is essential to have mechanism as simple as possible for opening and closing the lower lids, especially when there are several retorts in a setting. The devices in general use for this purpose consist of cog-wheels mounted loosely at the ends of the shafts operating the lids, and gearing with one common rack. Consequently, when one of the lids has to be opened or closed, it is necessary first of all to connect the shaft with the cog-wheel by means of special couplings. There





are certain inconveniences attending the working of these devices; and M. Louis Gümz has invented an arrangement for overcoming them. For this he has taken out a patent for France; and the following particulars are translated from the specification.

As will be seen from the illustrations, the cog-wheels are keyed firmly on to the lid-shafts, for each of which a rack is fixed on one common rotary pusher-shaft; the various racks being so keyed that there is never more than one lid-shaft engaged at the same time. The drawings are self-explanatory.

Fig. 1 shows two retorts only; but the device is applicable to a larger number. The lid-shafts are indicated by A; the cog-wheels by B; the retort-lid fasteners by D; the mechanism for closing the lids by E; the racks by F; and the pusher-shaft by G. To open or close one of the retorts, the wheel H is turned by means of the crank I (fig. 2), so as to make the shaft G turn until the required rack is engaged with the lid-shaft which it is desired to move. After releasing the closing mechanism E, the shaft G can be pushed forward. For working this shaft, a hydraulic motor C is provided, though power may be produced by any other means.

Sources of Energy Available for Power.

The President for the current session of the Association of Engineers-in-Charge is Dr. H. S. Hele-Shaw, F.R.S.; and at the recent opening meeting he delivered his address, which was on the subject of the "Sources of Energy Available for Power." Taking the sources of power in order of importance, as used in this country, he proceeded to consider them as follows: (1) The coal supply; (2) the liquid fuel supply in the form of mineral oils and petrol, and of any possible vegetable substitutes for these; (3) water and wind power; and (4) certain suggested forms of energy, such as the internal heat of the earth and the possibilities of radium. He emphasized the fact that it is a duty encumbent upon all to economize as far as possible the stores of coal in the earth. There is, he said, no one who does not feel that the reckless manner in which our predecessors have been allowed to denude this and other countries of timber is an evil thing; but the way in which much coal is now wasted is just as evil a thing as the destruction of our timber supplies—with the additional evil that the wasted coal is a source of dirt and fog, with all their accompanying evils.

In the list of Mayors for the current municipal year, we are gratified to see the name of Mr. W. A. Schultz, principal of the firm of Messrs. W. A. Schultz and Co., who has been elected for the second time Mayor of Deptford. His first election was in November, 1903, when he succeeded Mr. Alexander Dickson, the Chairman of the Bromley and Crays Gas Company. Mr. Schultz is Chairman of the Annfield Plain and several other gas companies, and Secretary of the Ascot District Gas and Electricity Company. Other gentlemen associated with gas or water supply are: Alderman G. S. Elliott, elected for the seventh time Mayor of Islington, is the Vice-Chairman of the Metropolitan Water Board; Alderman E. Finn, the Mayor of Lydd for the twenty-fourth year in succession, was formerly Chairman of the Lydd Gas Company; Alderman W. Lewis, the Mayor of Merthyr Tydfil, is a Director of the Quaker's Yard Gas Company; and Alderman R. Thornton, the Vice-Chairman of the Elland-cum-Greetland Gas Company, has been re-elected at Brighouse.

REPAIRS AND MAINTENANCE IN GAS-WORKS.

Part IV.

By a Works Engineer.

Hose-Pipe.

Hose-pipe varies so much in quality, and is only proved by practical experience, that it is easy to go wrong in its purchase. Such a large quantity of inferior hose-pipe is put upon the market that a lot of trouble must be taken to get a good article. For hydraulic use, the writer has found that a special type of hose-pipe supplied by a well-known firm is particularly suitable; so much so that during the last three years only 660 feet have been used for working two Arrol charging-machines and two coke-pushers, during which time at least 120,000 tons of coal have been used in the retort-house served by these machines. The hose pipe is $\frac{11}{16}$-inch internal diameter, and costs 2s. 3d. per foot. Considering that 240 feet of hose pipe is in daily use it will be realized that the wear has been exceptionally good. The working pressure is 550 lbs. per square inch.

When required for quenching coke and other low-pressure uses, there is no doubt that the flat type of armouring is preferable to the ordinary round wire armouring, as, being wider, it acts as a better support to the material of which the hose-pipe is made. There is, too, less chance of it bulging and giving way between the armouring. For ordinary purposes, the writer has found nothing so good as canvas braided hose-pipe. In this case, the hose has a strong jacket of stout canvas, plaited herring-bone fashion on its external surface. This type of hose-pipe is very cheap, taking into consideration its undoubted wearing properties.

Packing.

The types of packing on the market are legion, but only one or two points in connection with it will be mentioned. For steam glands, the well-known wedge packing is excellent, owing to its ingenious formation, by means of which an even pressure is always exerted around the entire rod. In the case of hydraulic machinery, a very efficient type of packing-ring may be obtained, on the lines of ordinary cup leathers, on which, however, they are a great improvement. It is so constructed that, as soon as the pressure is exerted, the ring is forced outwards against the ram, effectually preventing the escape of water in a manner which shows a good improvement on ordinary packing. With these rings, the gland is never tightened-up as with packing; as the pressure itself is caused to tighten-up the rings. This is a much more scientific method of keeping a gland tight than is provided by ordinary packing. Packing suitable for both steam and water glands may now be obtained made up of $\frac{1}{4}$-inch strands, which may then be rolled up into two, three, four, or more strands to make any size of packing as required. The sizes can be varied into a wide range, as the strands may be rolled up tightly or loosely, and may also be stretched or hammered to give a smaller diameter. This is very convenient, as only the one size need be kept in stock—a great advantage, owing to the fact that, with turned-up rods, slight variations in the substance of the packing are required.

The Use of Expanded Metal.

This excellent material, made by a most ingenious process, can be used for several purposes in gas-works. It is specially suitable for re-inforcing concrete in all kinds of building work, and is also extensively used for machinery guards, window guards, and fencing. The writer has, however, found another purpose for which it is admirably adapted, and that is for coke, breeze, and oxide screens. At the present time, it is being used with much advantage in a jigger screen working on pan breeze. Previously, plates perforated with round holes were used; but these were replaced by $\frac{3}{8}$-inch diamond mesh expanded steel plates at exactly one-quarter the cost; and the material was much more efficient for screening purposes. It was indeed found that a sheet of expanded metal 4 feet long was capable of screening as much material as perforated plates 6 feet long. This is probably due to the fact that a larger proportion of its surface is space, and that its uneven face causes the material to be more thoroughly shaken. It has also the advantage that it clears itself of the material to better advantage than does the perforated plate; and very little, if any, of the material is found jammed in the holes. This is an important consideration, as it is not an uncommon sight to see at least 25 per cent. of the holes in a perforated plate placed *hors de combat* for this reason.

Manganese Steel Bolts.

The quality of the bolts used on machinery, and especially on parts in which the bolts are called upon to withstand sudden shocks, is an important matter; and the writer has on occasions traced a bad breakdown to the fracture of the bolts used to hold the parts together. Especially is this the case on stoking machines, which, in the course of their work, receive a good deal of shock. Much improvement resulted in the writer's works from a substitution of ordinary bolts for those of manganese steel. The latter are, of course, more expensive; but this is a small matter in cases where it is possible to save costly breakdowns of machinery. The bolts cost from two to three times as much as ordinary bolts; but in many cases, where there is much wear, they are found to last at least ten times as long. It is almost impossible to break them; and in practice they may be relied upon to bend rather than break. It is distinctly unwise to use cheap bolts for fixing expensive parts of machinery—a few extra pence spent on the bolts may be the means of saving many pounds on machinery used at a works.

Protecting the Working Parts of Pumps.

In many works where the pumps are fixed separately from each other, it is the practice to erect sheds over them to protect them from grit and dirt, which would be likely to cause exceptional wear and tear. This is undoubtedly a wise practice; but it may be improved upon by fitting neat wooden cases over the working parts. The cases are provided with hinged doors fitted with glass, so that the packing of the glands and the lubrication of the pump may be effected without difficulty, and also that it may be readily seen that the pump is working properly. The castings of the pump are, of course, left uncovered; and it need not be thought that the cases in any way detract from the appearance of the pump. A shed, to be of any use, must be kept closed; and it is then impossible to see whether the pump is working properly without going into the shed. With a cover as suggested, however, it is a convenience to be able to pass and see at a glance that the pump is working satisfactorily. In this way, the cost of the building and upkeep is saved; the pump suffers in no respect; while supervision is rendered easier.

Scaffolding.

There are a good many objections to the use of scaffold cords. Many accidents have been caused by the cords rotting unobserved; and there is always the risk that due care may not be taken to examine the cord before using it. It is not easy to detect a perished cord—it is a matter that calls for a practised eye. It is, too, a disadvantage that the work of scaffolding must be done by an experienced man, who is not always available when wanted. Then, again, it costs money for both labour and wear and tear; and this is no small item when carrying out building operations. The writer has for some years discontinued the use of scaffold cords and, as a substitute, has adopted "Scaffixers." For those who have no knowledge of this arrangement, it may be as well to give a short description. Electrically-welded galvanized chains are used in place of scaffold cords. These chains are tightened up by hooking the ends on a screwed-block, which is then screwed up by a spanner until perfectly tight. There are four hooks on each block, and one chain is used for each pole; so that two chains and one block are required to make a complete tie. In making a tie, a bracket, temporarily fixed to the vertical pole by a chain passed round it, is used to support the horizontal pole. The whole operation is effected in a few minutes, and may be carried out by any man who has ordinary intelligence. As the initial cost is low, and the life a long one (at least ten or twelve years), the use of "Scaffixers" is a distinct economy both in labour and material. Their adoption is also desirable on the score of accident prevention.

Welding Fractures.

It is not yet universally known that any fracture, whether in wrought or cast metal, may be satisfactorily welded by a blow-pipe at reasonable cost. In the case of expensive castings, such as engine and pump cylinders, valve boxes, &c., in which much machining has been done, a good deal of money may be saved by welding a fracture by the oxy-acetylene process. The writer's first acquaintance with this system was after two large pump cylinders of a hydraulic pumping-engine had cracked to the extent of about 10 inches in the body. The irregularity of the outside of the casting rendered the packing of the crack quite impossible—more especially as the working pressure was 750 lbs. per square inch. Two new pump cylinders were ordered at a cost of £27 each, much of the cost of which was due to the machining of the castings and the initial expense on pattern making. The two fractured castings were then welded at a cost of £5 each. Since that time, one has been in use for nearly three years, and has proved quite satisfactory; while the other is being retained as a spare one.

Many examples of similar satisfactory jobs could be mentioned. Excellent work may be carried out in executing boiler repairs. Weak places in the plates can be cut out and new pieces welded in quite successfully, and in such a manner as to be immeasurably superior to the old method of patching. Such work has long passed the experimental stage, as is shown by the extent to which it has been adopted by prominent engineers for scores of difficult jobs. The writer considers that the time is ripe for gas companies to demonstrate the practicability of using oxygen and town gas for such welding work. For the cutting of wrought metals, it has already shown its utility; and it only needs experimental work to prove its usefulness for welding.

Wages on Repairs.

Having dealt at some length with the question of materials used for the purpose of repairs and maintenance, a few points as to the repair staff may now be discussed. The wages paid to such men usually exceed the amount spent on materials for their use. It is, of course, impossible to specify the requirements of any works in this respect. The writer subdivides the wages on repairs and maintenance into the headings shown on p. 582.

Sunday Work and Piecework.

Some of the items are increased by reason of Sunday work, which is included in the above figures. A good deal of Sunday work is essential in a gas-works; but it is surprising how much

Division of Repairs and Maintenance Costs.

	£		Per 1000 Cubic Feet of Gas. d.
Mechanics, turners, and labourers	1088	..	0·261
General works fitters, including pipe and gas fitters, and labourers	792	..	0·190
Bricklayers, including mortar mill attendant, and labourers	758	..	0·181
Stoking machine fitters and labourers	584	..	0·140
Flue cleaners and retort scurfers	425	..	0·102
Smiths and hammermen	395	..	0·094
Carpenters and labourers	376	..	0·090
Platers and labourers	334	..	0·080
Painters, tinmen, and glazier	204	..	0·048
Mouthpiece and furnace door fitters	185	..	0·044
Yard labourers	214	..	0·051
	5355	..	1·295

will be left to be done on a Sunday unless the matter receives attention on the part of the responsible officials. It is a good idea to have a book kept, in which is stated the amount and cost of work done overtime and on Sundays, with a view to reducing it as much as possible. It is often possible to so alter valves and connections as to enable repairs to be undertaken while at work instead of at rest.

As regards piecework, there is no doubt whatever that work may be done at least 30 per cent. cheaper than if done by day-work, provided the quality of the work is properly supervised. There are the additional advantages that the cost of the work is known, and also that a job is completed in quick time. It is advisable to specify the hours which the man is to work; otherwise he will sometimes work so late at nights as to get the work done unnecessarily quickly, with the result that jobs must be found to keep the man going on daywork. In this way, the work may become excessively expensive, as the man will reserve all his energy for piecework.

Injuries to Workmen.

The writer does not propose to deal further with the question of the men employed on repairs and maintenance. A good deal could be mentioned on the best methods of getting the greatest efficiency from workmen; but it would be largely repetition of well-known principles of good management. There is, however, one aspect of wear and tear which should not pass unnoticed, and that is the prevention of accidents, and the treatment of injured workmen. As regards the former, nothing but constant watchfulness in the care with which dangerous machinery and work are guarded can minimize the risks of accidents; while in the case of the latter, it is a wise plan to appoint one man to attend to all minor injuries and wounds. This man must have some experience, and be interested in the work.

In any large body of workers there are usually one or two men experienced in first-aid work. Failing this, it is not difficult to persuade a suitable man to take up the subject on the promise of a small increase in wages when proficient. At the writer's works, the storekeeper undertakes the duty. He is provided with all the necessary appliances and antiseptic dressings for the treatment of open wounds. Some hundreds of minor cases have been treated with complete success; and there is no doubt that, had there been no facilities on the works for obtaining proper and immediate attention, a certain proportion of these would have resulted in blood-poisoning and all its attendant dangers. Wear and tear of human life and limbs is by no means the least of this important item in the manufacture of gas.

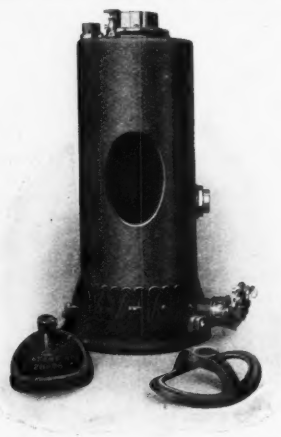
The Gas-Turbine.—We have received from Messrs. Charles Griffin and Co., Limited, a book bearing the above title. It is a translation by Mr. A. P. Chalkley, B.Sc. (Lond.), of a work by Herr Hans Holzwarth dealing with the theory, construction, and records of the results obtained from two actual machines, with additional notes by the author. The text, which occupies 129 pages, is fully illustrated; and there are numerous tables. The book, which is published at 7s. 6d. net, will be noticed more fully in an early issue.

"Transactions" of the North British Association.—We have received the report of proceedings at the fifty-first annual meeting of the North British Association of Gas Managers, held in Aberdeen on the 5th and 6th of September, under the presidency of Mr. Samuel Milne, the Corporation Gas Engineer and Manager. The technical matter, which includes the "Young Memorial Lecture" on "Carbonization" by Dr. Harold G. Colman, and the "Appreciation" of Mr. Young by Dr. Beilby, was given in the "Journal" at the time. It is preceded by the annual report of the Council and the accounts for the year ended June 30; and followed by lists of officers and members. Appended to the report of the proceedings is the "Statistical Report of the Gas Supply of Scotland" for the year ended May 15, published by the Committee of the Association. A photograph of the members taken at the Marischal College, where the meeting was held, forms the frontispiece; and there are portraits of the President, the readers of three of the papers (Messrs. Keillor, Langlands, and W. Carmichael Peebles), and Dr. Colman. The book has been produced under the supervision of Mr. Lawrence Hislop, of Uddingston, the Secretary of the Association.

THE "SPIRAL-CIRCULATOR."

Hot-water circulators have become so important from the point of view of sellers of gas, that no apology is necessary for calling attention to anything that is likely to still further increase their popularity among consumers. Hot water is a necessity for domestic and other purposes; and in any apparatus designed to supply this want, three highly desirable characteristics are efficiency, simplicity, and low cost of maintenance. These qualities are, it is claimed, possessed to a marked degree in a new patent appliance, named the "Spiral-Circulator" water-heater, which is being put on the market by Messrs. Wilsons and Mathiesons, Limited, of Leeds. As to two of the points, we can ourselves speak—having been afforded an opportunity of inspecting the apparatus. It is extremely simple and very strongly made; and the construction and principle upon which it works are such as to reduce maintenance costs to a minimum. As to the remaining point, the firm state that the average efficiency of this new model, owing to the ease with which it can be cleaned and maintained in good working order, is superior to that of any of its predecessors.

The circulator is what is termed internally heated—that is to say, the heat passes up inside the water. There are two cylinders, and between these the water circulates. Inside the internal cylinder or flue there is an iron spiral, up which the heat passes—travelling something like 5½ feet from the time of entering the cylinder to leaving it. Thus the water is heated through the medium of three processes—flame contact at the bottom, the contact of the products while travelling up the heating chamber, and radiant heat from the iron spiral. The effects of condensation are practically done away with; for in passing down the spiral the moisture must travel inwardly, and before it gets to the bottom, it has dried up—leaving on the spiral merely a little white powder, which can be brushed off. This spiral, it may be remarked, is not fastened in any way, so that for cleaning purposes all that it is necessary to do is to lift it out. The outer casing of



The "Spiral-Circulator" with Manhole Open.

The Iron Spiral, which Fits into the Flue.

the apparatus is seamless and stamped from one piece of copper, while the inside is constructed from two pieces of copper brazed together. Between the two cylinders, there is a water space of 2 inches, without any obstruction whatever. By the provision of this space free internal circulation of the water is secured, in addition to the flow and return. It will be noticed from the illustration that in the front of the outer casing there is a manhole, the cover of which is held in position by a single nut. This cover is provided with a rubber washer, which will take-up any inequality in the metal, and make a perfect fit without the exercise of a great amount of force in turning the nut. On the removal of the cover, every portion of the space between the two copper cylinders can be got at for the removal of deposit—there being sufficient room to allow of a man putting in his hand or tool. There is thus no need to disconnect the gas or water supply when cleaning operations are to be undertaken either in the matter of the flue or the waterway.

As has been pointed out, the circulator is practically one piece of metal, so that no leakage is to be feared. It is made in two sizes—No. 1 size being in two strengths, 16 and 18 gauge copper; and No. 2 size in 16 gauge. The first consumes up to 30 cubic feet of gas per hour, and is suitable for cylinder or hot-water storage up to 30 gallons; while No. 2 consumes up to 60 feet of gas, and is intended for anything up to 60 gallons. It is in all respects an eminently serviceable article; and the makers feel the greatest confidence in introducing it to the sellers and users of gas. Messrs. Wilsons and Mathiesons remark that the "Wilson" circulator was the first hot-water circulator to be introduced, and was exhibited at the Earl's Court Exhibition in 1904; and they add that the "Spiral-Circulator" is the first of an entirely new construction to overcome the difficulties experienced with hard water and stoppage of flue-space.

REINFORCED CONCRETE FOR GAS-WORKS.

By J. Fisher, Tottenham.

[A Paper presented to the Southern District Association of Gas Engineers and Managers, Nov. 14.]

The subject which I am about to bring before you is one which I am sure is of interest to all the engineering members of this Association. I do not propose to deal with it theoretically, or to describe large and important works, but will only attempt to show the practical utility of reinforced concrete in the extensions and alterations of gas-works such as the growth of the industry fortunately demands, and further to give some illustrations of work that has recently been done at Tottenham.

Ordinary concrete, I need hardly remind you, is only of use on account of its mass or weight. It can be made from all sorts of hard material, and in varying proportions, of large stone or gravel together with sand, using cement or lime as the binding material. At the present time, in speaking of concrete, one usually means a material composed of ballast or gravel or broken stone, with a mixture of sand, and held together with Portland cement. The proportions vary from 4 of aggregate to 1 of cement (which is an extravagant mixture) to 13 of aggregate to 1 of cement (which is a very poor mixture, but still good enough for use for foundations on suitable soils and also for floor filling). For reinforced concrete, the proportions have become standardized to 4 parts of broken stone or gravel, 2 parts of sharp sand, and 1 part of cement. These proportions are by weight; and for cubic measurement, which is most usually employed, we take 1 yard of stone or gravel, ½ yard of sand, and 610 lbs. of cement. In using ordinary Thames ballast, which has about the proper proportion of sand in it, we take ½ cubic yard and mix it with 1 sack of cement.

The reinforcing of concrete consists in imbedding in it steel bars or other suitable sections, which, through the adhesion of the concrete, can be made to resist the tensile stresses. It has been found that there is very little difference between the expansion and contraction of steel and concrete at equal variations in temperature even up to 200° or 300° Fahr., and further that these slight differences cause such fine cracks that the adhesion of concrete to the steel is not destroyed. That is the important point. The adhesion is not impaired. But in all calculations for this class of work the concrete itself is considered to have no tensile strength; and the whole science of reinforced concrete construction, and also the subject-matter of numerous patents, is the placing and arranging of the steel to resist the combined stresses of tension and shear. Further, the combination of the two materials results in an increase of strength that is not generally realized.

With a view to making this clear, and to demonstrate to you the extraordinary increase in the strength due to a very small addition of steel suitably placed, I have prepared three model beams, which I will proceed to test. In size the three are alike, and represent a beam 20 feet span, 20 inches in depth, 16 inches in width. The specimens are one-twelfth of the actual size. The first is plain concrete without any steel; and on placing it in this simple arrangement for applying a concentrated load, it will be found, if the experiment is successful, to break with a load of 30 lbs. In the second beam, two steel rods have been imbedded in the underside, as shown in fig. 1. The area of the steel is only 0·0067 of the

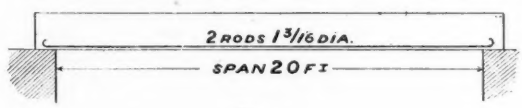


Fig 1.

total area of the section. It will be found that a weight of 160 lbs. is sufficient to destroy this beam, an increase of 433 per cent. In this example, the reinforcement is not correctly placed, and no provision was made to resist the diagonal stresses due to the combination of tensile and shear stress. In the third example (fig. 2) these stresses are provided for by using four rods instead of two.

Fig 2.

Their total area is the same as before; but two are bent upwards to resist the diagonal stress referred to. Before testing this, I must particularly direct your attention to an important attribute of reinforced concrete—namely, that it will bend before breaking; in fact, if the elastic limit is not exceeded, it returns to its original position when the load is removed. I need hardly emphasize this important feature. It means that a structure will not collapse suddenly under a steady or dead load; it means that warning will be given by the flexure and by the opening of cracks long before any collapse takes place. Before proceeding to test this last model to breaking-point, I will put in a simple arrangement to magnify the deflection, and apply first the safe maximum load, on removing which you will see the pointer returns to zero. With the load of 160 lbs. which broke the last specimen, the pointer does not return to zero when the load is removed, showing that a permanent set has taken place. A load of over 200 lbs. must now be applied in order to completely fracture the beam. These loads, multiplied by the square of the natural scale of the model, would give the corresponding strengths for the full-size beam of 20 feet span. I have three more of these specimens which can be tested at the close of the meeting if any of you feel disposed to examine them more closely and to try them for yourselves. I should also note that this arrangement is by no means an ideal one, but was only devised to allow you to view the effect of the loading as clearly as possible.

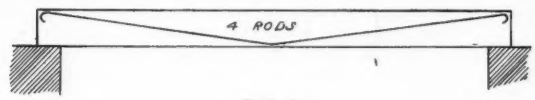
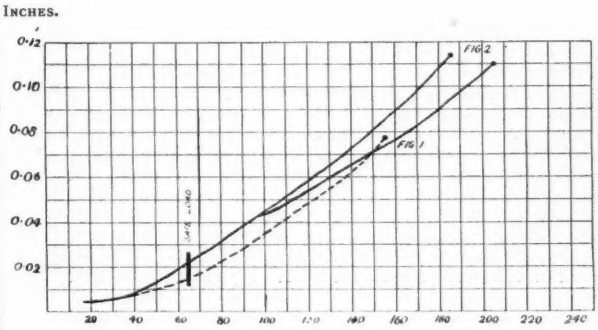


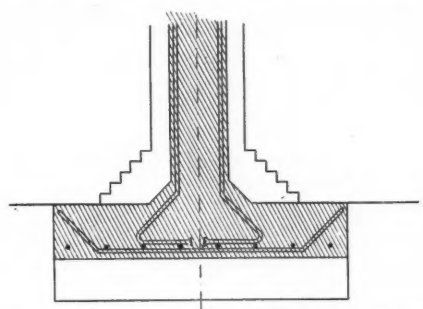
FIG 2A



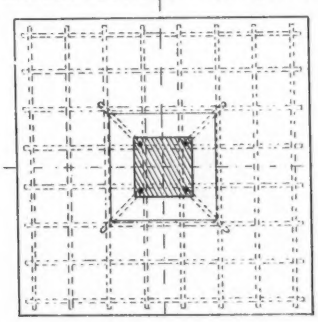
Deflection of Model Beams.

Now as to columns. An equally remarkable increase in strength is again attained by the addition of steel. Usually vertical rods are introduced; but these alone are not sufficient, as under heavy loading there is a tendency for the column to burst apart. This can be overcome by binding the column with helices and wire, or inserting transverse rods—in fact, as regards ultimate crushing strength, the same amount of steel used in the form of a helix or transverse rods is nearly three times as effective as when used in the form of vertical rods. A column, however, without vertical rods has little resistance to buckling, and a combination of the two methods is now universally adopted.

Let me now direct your attention to some of the practical advantages in using reinforced concrete, and start with foundations. It is rarely that one finds a soil sufficiently firm and solid that foot-



CONTRASTED SECTIONS-BRICK & R^D CONCRETE



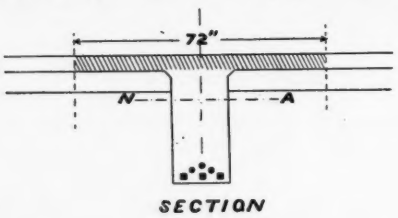
PLAN

Fig 3.

ings for a heavy wall or column can be laid directly on it; and a bed of concrete is almost always put in to distribute the load. Such a bed is made of sufficient size and thickness to distribute the thrust of the column or wall through an angle of 45° over an

area large enough to bring the distributed load within the limit that the class of soil has been found to be capable of sustaining. I have in mind columns to support a workshop floor. The weight of floor and loading on each was about 80 tons. The columns were of blue brick in cement, 27 inches square, and their weight about six tons. On London clay, which can safely carry 2 tons per square foot, the area required was, therefore, 43 square feet; and, for safety, the concrete foundation for each was made 7 feet square by 2 ft. 3 in. deep. Now had a concrete column been used with 1½ per cent. of longitudinal steel, and 1 per cent. of lateral steel, the safe load it could carry would be 660 lbs. per square inch. The column required would thus be 16½ inches square, with a vertical reinforcement of four rods, 1½ inches diameter. The area of the concrete footing would have necessarily been the same size in order to keep the distributed load within the safe limit; but instead of requiring to be 2 ft. 3 in. thick, 1 ft. 3 in. would be quite sufficient, with a steel reinforcement of ⅝-inch rods 12 inches apart. Fig. 3 illustrates this; the reinforced column and foundation being shown shaded.

Now supposing this column is to support a floor. Hitherto the actual decking has been so much dead-load to be carried by the beam or arch, in addition to the working load. But with reinforced concrete this is not the case; for being monolithic in structure, the strength due to the decking is added to the beam, and that not merely in increasing the effective depth of the beam by the thickness of the floor slab, but because it acts as a wide flange of concrete to resist the compression. In this way, beams can be made immensely strong. With a plain beam you can only use a small percentage of steel economically, because you cannot get sufficient concrete in compression to equal the tensile stress the steel could sustain; but with a beam and slab combined, you can load-up the underside of the beam with steel to a very great extent, the only precaution necessary being to allow 1½ inches at least of concrete between each bar. Fig. 4 illustrates this.



SECTION

Fig 4.

These same remarks apply to roofs, with the exception that the loads on roofs are very much less than on floors. Reinforced concrete roofs are now frequently made on the lines of timber structures, and even of the saw-tooth type; but I do not consider the material suitable for anything but flat roofs. And here a little practical note may be of interest. A roof that is not water-tight is not worth calling a roof. We have at Tottenham one made of clinker-ash concrete only 3⅛ inches thick, laid carefully, but with no exceptional precautions, and that was made perfectly water-

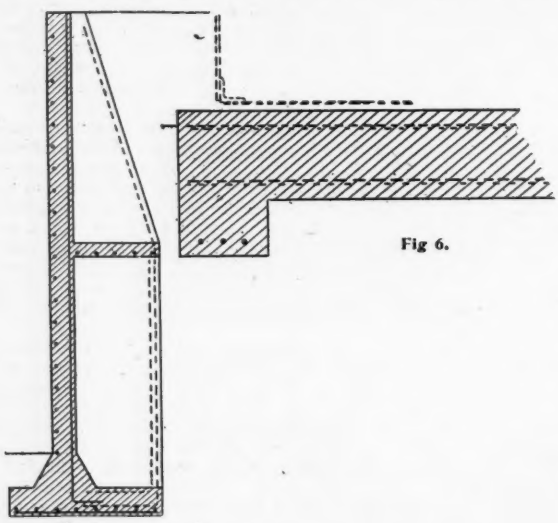


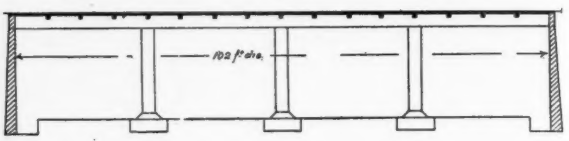
Fig 5.

Fig 6.

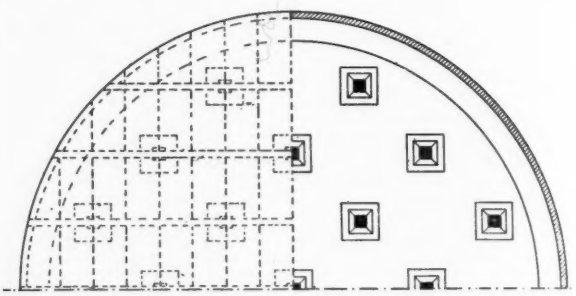
tight by giving it two coats of tar boiled with a little pitch, and then dusting it over with carburetted water gas "fliers."

As this part of the paper has been dealing with buildings, I may as well say a few words about the walls. Numbers of buildings have been erected with walls of reinforced concrete. The concrete is put in in layers; and as each layer set the timber or shuttering is moved up to receive the concrete for the next layer. These structures are doubtless light and strong; but their appearance cannot be described as artistic, nor do I think are they cheap. The present tendency is to make a strong framework of reinforced concrete, and to fill in either with 4½ inch brickwork or moulded concrete blocks. These latter look like stone, and are light and effective. There is another class of building which consists of a steel framework, to which is attached some form of expanded metal to carry a facing of concrete. The concrete acts merely as a veil to resist the weather; and such structures, whatever their merits, cannot be classed as reinforced concrete.

Another simple engineering work that frequently has to be done in a gas-works is the erection of a retaining wall either on account of varying levels of the soil or for the storage of coal or coke. These retaining walls I have called simple, but they can prove very troublesome. Hitherto, the practice has been to put in a solid mass of concrete or masonry, which by its weight resists overturning; but with reinforced concrete a much lighter form can be employed. A wide base can be used, on which the toe of the embankment rests, so that the soil itself gives the necessary weight to prevent the light facing wall from being overturned. This facing wall is strengthened and prevented from breaking away from the footings by L-shaped reinforcing bars. For high embankments, a ledge or platform half-way up can be employed; and it is possible to design such walls so that they would tilt backwards if the subsoil allowed any movement at all. Fig. 5 illustrates such a wall.

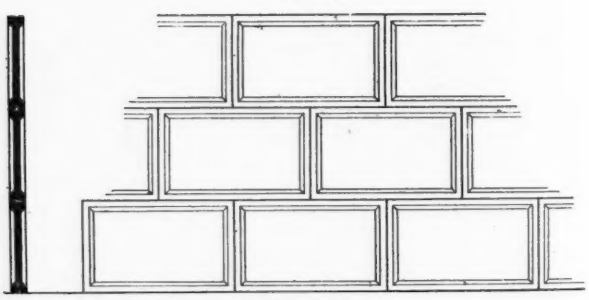


SECTION



PLAN

Fig 7.



ELEVATION

Fig 8.

It is useless to attempt to describe all the purposes for which reinforced concrete has been successfully employed; but I ought to mention particularly its suitability for tar and liquor tanks underground, and for foundations of steel tanks above ground. With these latter, there is usually a heavy distributed load, the soil over their considerable area is seldom uniform, there is the added weight of the tank sides, and possibly guide-framing to be provided for. Fig. 6 shows the type of foundation usually employed. For moderate sizes, the slab is usually made about 1 ft. 6 in. thick with two layers of reinforcement; one about 3 or 4 inches from the bottom, and one three 3 or 4 inches from the top. Each layer consists usually of two thicknesses of expanded metal, with the meshes running in opposite directions. Reinforced concrete has also been employed instead of brick and puddle for gasholder tanks; but the conditions for these vary so widely that it would be unwise to say more than that it seems a suitable form of construction for at any rate small and medium sized tanks.

Having now indicated how reinforced concrete can be usefully and often economically employed in a gas-works, may I draw your attention to the following examples of work recently done at Tottenham? Fig. 7 shows a gasholder tank converted into a tar and liquor well and provided with a floor of reinforced concrete, on which workshops are constructed. Fig. 8 shows the walls of these workshops; the blocks being cast from our own clinker screenings. They were cheaply made and erected. The reinforcement in each consists of any bit of old pipe or metal that

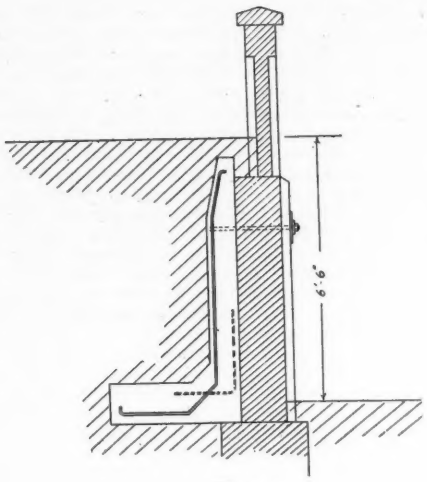
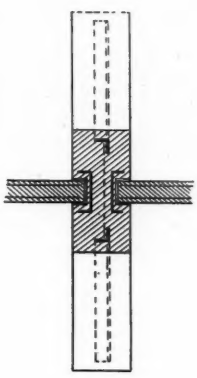


Fig 9.



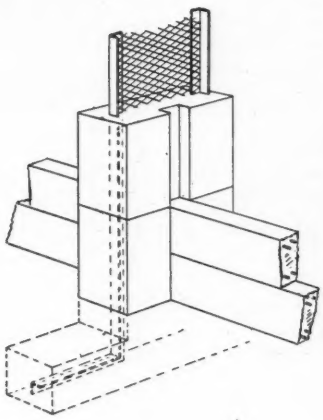


Fig 11.

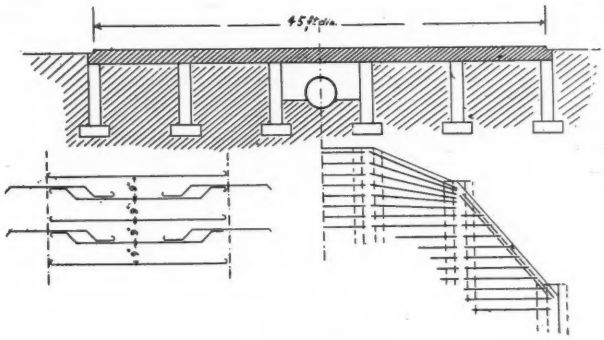


Fig 10.

could be obtained from the scrap heap. Though only 2½ inches thick in the panels, they support the girders and roof of the workshop; and in one case the electric driving motor is fixed in the roof. Fig. 9 shows a backing put in to support a retaining wall which had been pushed out of vertical by the making-up of the ground on one side. Fig. 10 illustrates the foundation of a steel tank in which the virgin soil was at a considerable depth down, and across the site of which a large gas-main was in existence which could not be moved.

I indicated earlier in the paper that the tendency in wall construction is to fix strong reinforced framework and fill in between with moulded blocks. I have illustrated in fig. 11 such a form for the purpose of constructing bins under a coke gantry. The first two angles, with expanded metal between them, are embedded in a concrete footing. They will be lightly connected at the top to hold them rigid, and the concrete pier formed round them. A dry mixture of concrete would be used and well rammed, so as to allow them to be run up quickly. The columns would be moulded with a groove in each side, into which slabs about 4 inches thick (previously made) would fit; and each slab as put into position will form a support for the mould in making the next section of column above it. This work is not yet begun; but I am confident that it will prove successful.

Now as to the various systems of reinforced concrete, I might almost repeat the expression used of an Englishman's beverage—"None bad; all more or less good." There are the Hennibique, Coignet, Considere, Kahn-Bar, Indented Bar, Expanded Metal, &c. Each has some advantage or disadvantage. Those of you who have had experience of reinforced concrete know the difficulty there is in keeping the reinforcements in place during construction; and a system such as the Kahn-Bar, which obviates this difficulty, is certain to commend itself to you. The patented systems are of chief use where important works are to be carried out; for then you get the results of long experience—first of the designers, and then of the various firms who carry out the work. But for work of minor importance such as I have been describing, ordinary sections of steel can and should be employed. There is no patent about using ordinary sections, and no bolting or joining together is required; while only in very exceptional circumstances should there be more smith work than bending or cutting.

The proportions for concrete I have already indicated. The usual working loads are taken as 600 lbs. per square inch for concrete in compression, and 16,000 lbs. for steel in tension. With these strengths the neutral axis of a beam is found to be ·36 below the top of the compressive surface. With T beams, the position of the neutral axis bears the same ratio to the total depth as with rectangular beams; and in cases where it falls below the depth of the slab, the area between the neutral axis and the slab is disregarded. When steel is used in compression, a variation is introduced; but there are text-books which give the necessary calculations without highly complicated mathematics, and diagrams for the solution of such beams can also be obtained. The shuttering employed should be sound and rigid; and it is usually a rather expensive item in this class of work unless there is considerable repetition. It is usually safe and advisable to remove the shuttering from the underside of floor slabs and the sides of beams in four or five days. But the supports of main beams should not be removed until the concrete is thoroughly set; and a safe rule is to allow 1½ days per foot of span, with 30 to 35 days as a limit. For important works, loads approximating to the maximum should not be applied until at least five weeks have elapsed from the time the concrete is laid; and for test loads of 25 to 50 per cent. in excess of the maximum, from eight to ten weeks at least should be allowed,

It is also advisable when testing beams or floors to have supports under but not touching them, so as to prevent a collapse in case the beam or floor should fail under the test. These supports serve a useful purpose in carrying some form of instrument to measure the deflection. A practical rule as regards deflection is that it should not exceed 1-500th of the span.

As regards mixing the concrete, wet mixtures are now generally favoured, because there is far less disturbance of the reinforcement when working with wet mixtures. These latter, however, are very useful for moulding blocks where the reinforcement is of a simple character; for the mould can be removed immediately and a great number of blocks can be made from one mould in a day. The dry mixture, too, attains its full strength more quickly than a wet mixture, though not finally so strong. A dry mixture is moistened with just sufficient water to make it cling together when pressed firmly in one's hand. These mixtures require to be well rammed.

It is stated in the report of the Committee of the Institution of British Architects that concreting should not proceed when the temperature is below 34° Fahr. This doubtless is a safe rule. I have, however, seen good work done when the temperature has been 31°; but when it is necessary to work under such conditions, great care must be taken to see that the steel is dry and not coated with a film of ice, which would prevent the adhesion of concrete to it.

Endeavours are being made at the present time to improve the appearance of concrete work without having recourse to plastering or rendering, which is not very satisfactory for exteriors on account of its liability to crack and peel off under the action of the weather. One method of dealing with panelled work is to etch away the surface of the panel with hydrochloric acid, leaving the aggregate exposed. If the concrete has been made of stone or flint of varying colour, a very pleasing effect can be obtained. I have here a small specimen for you to examine. Some decorative effect of this sort, in combination with good design as regards form and lines, should go far to prevent unsightliness in concrete structures.

With these remarks, I will conclude my paper, trusting that I

have been able to give a few practical hints and ideas that may be of use to you, and hoping that it will give rise to a good discussion. I also desire to thank Mr. Broadberry for his kind permission to make use of the work done at "Tottenham" to illustrate the paper; and at the same time to remind you that it is due to his initiative that many of these jobs have been carried out.

Mr. FISHER, in introducing his paper, remarked that he wrote it before he had had an opportunity of undertaking confirmatory experiments; and the results he had since obtained did not in every respect agree with what had been put in the paper. He then proceeded to test three model beams as explained in the paper. The first experiment demonstrated the suddenness of the fracture, under a concentrated load, of ordinary concrete. The second was with a beam reinforced with two steel rods right along the bottom. Though it was pointed out that in this case the reinforcement was not properly placed, the failure was a gradual one, and the beam was much stronger than the plain concrete. The third experiment was with a beam in which provision was made to resist the diagonal stresses, by using four rods instead of two—two being bent upwards. In this case the failure (under a still greater weight) was very slow; and even when slowly bending there was, with a reduction of the weight, a tendency on the part of the beam to return to its original shape—showing that there was still some elasticity left in it. A material which acted in this way, he said, was a satisfactory one for them to use. Referring to a matter not dealt with in his paper, Mr. Fisher said that many of those present were no doubt perturbed on reading an account recently published in the Technical Press regarding the severe electrolytic action which had taken place in an American building. They might, however, be reassured on examining the article in question, to find that such conditions were hardly likely to be reproduced, at any rate in a gas-works. They were, he was sure, absolutely exceptional. With a view to testing the effect of the electric current, he prepared a small sample of concrete, and subjected it to the current from two ordinary dry cells. The sample of concrete was immersed in a saline solution; and it was completely fractured in about six days. On testing the model beams he had on the table for electrical resistance, he found that this resistance amounted to not less than 3 megohms, which was all that was necessary for proper insulation. What, therefore, he recommended was that in the first place reinforced concrete structures should be very carefully protected from leakage of electric currents, and, further, that the concrete should be made waterproof in itself. Unfortunately, there was nothing very definitely agreed as to the best method of making concrete watertight. A slight mixture of oil had, however, been found effective, and at Tottenham they had used a patented material—which was, he believed, calcium soap. But whether this would prove sufficiently permanent, he was at present unable to say.

Discussion.

The PRESIDENT (Mr. B. R. Green, of Mitcham) remarked that the paper was now open for discussion. Those present would agree that the method Mr. Fisher had adopted of making his experiments was exceedingly ingenious. He believed it was the author's own idea. Of course, one could hardly expect that beams of so small a calibre would give precisely the result that might be expected from them. Mr. Botley, he thought, had had some considerable experience with reinforced concrete construction, and perhaps he would open the discussion.

Mr. C. F. BOTLEY (Hastings) remarked that he could not help thinking that those who were contemplating the use of reinforced concrete must derive great assistance from the paper, the value of which was much enhanced by the very ingenious experiments that had been carried out before them. It was not to be expected that these experiments would coincide exactly with work carried out on a very large scale; but they were quite sufficiently accurate to be instructive. It was true that he (Mr. Botley) had had an opportunity of doing a good deal of work in reinforced concrete. But unfortunately it was some time ago; and the science was not then so far advanced as was the case to-day. It was, perhaps, ten years ago that he was engaged upon it to any large extent; and there were considerable doubts then as to how far one could go with safety. Several of the systems which were now available, he believed he was correct in saying, did not then exist; and to a large extent the work which he carried out was done by using expanded steel which was correctly proportioned according to the work for which it was required. At that time the people supplying this expanded steel had gone into the theory as much as they could, and they were very helpful in assisting one with any design that might be put before them. It might perhaps be interesting if he briefly indicated some of the ways in which he had employed the system—always, he might say, with great success. The foundations of the retort-beds were dealt with by expanded metal. The floors of some large water-tanks of curious shape—inverted—were also dealt with in the same way. The subsoil was exceedingly doubtful. It was that sort of subsoil which was quite inconsistent—some good and some bad places; and consequently it was necessary to have a material with which one could cover the surface securely without taking so much room as to seriously interfere with the capacity of the water-tanks. For this purpose, both for the floors and the cross walls on which the superstructure was carried expanded metal was used, with very great advantage. On a stage floor, he believed he was able to reduce the floor in bulk by one-third of what would be ordinarily used. In the purifying-house, also, the floors were made with expanded steel. In this case, the floor was designed in connection with lime purification under the sulphur clauses; and he did not allow for the fact that, in the march of events, they might later on want to use it as an oxide revivifying floor. It was true that the amount of water they now had to employ in connection with this was not great. But there was the objection in this particular floor that he did not make it sufficiently waterproof; so that if they were to use it for the revivifying of oxide, and employed water very considerably on it, they might affect the iron inserted in the lower surface as part of the reinforced concrete. It had not become a serious matter, for the reason he had indicated; but it undoubtedly would become serious, if one had to utilize water very extensively. Another interesting application, something like the author referred to in regard to the tank foundation, was the case of putting a very large storage tank, 60 or 70 feet diameter, and holding about 250,000 gallons, on a portion of the site which was absolutely bog. For a long time, he looked round for a site for the tank, which he wanted to put in a place where it would not take up useful space; and at last the spot he referred to was decided upon, as he felt they could not put anything else there. He calculated that it would undoubtedly go down when the soil was compressed, and that the only thing he could do would be to make the foundation so strong that it would not break. Now, expanded metal was, of course, the ideal for this particular purpose; and though it compressed the soil and went down, and did not go down quite level, the concrete was intact, and had proved a highly satisfactory job. Since the time when he was engaged actively on this work, they had had many more of these systems, which were useful for numerous purposes in construction work. Now they employed the principle of reinforced concrete, taking metal that might be on the scrap-heap, and applying it intelligently. He had had the pleasure of seeing some of the work at that inspiring place Tottenham which Mr. Fisher had been engaged upon; and the author had rather confused him for the moment in saying the converted gasholder tank had a floor of reinforced concrete, instead of a roof. However, he might be forgiven for this. He had also seen the panels made there; and if there were any present who had not done so, he could assure them it was most interesting. If ever he had to do any of this kind of work again, he would think very seriously of using panels made after the fashion of Tottenham. They had ash clinker available at gas-works, which made a splendid job.

Mr. H. C. HEAD (Winchester) said he had read the paper with great interest, and wished there had been more of the pretty experiments. The point which struck him as the most interesting about these experiments was the difference in strength between the specimen constructed as shown in fig. 2 and the one constructed as fig. 2A. Fig. 2A failed under a very considerably less load than fig. 2; and Mr. Fisher, while showing them that this was so, and explaining that he expected it would be so, did not give as much reason as he hoped he would have done. He (the speaker) thought that the reason why fig. 2A was not so good as fig. 2 was a matter on which others, as well as himself, would be glad to be enlightened. If Mr. Fisher would put him right afterwards, he would like to blunder along and talk a little about it. It seemed that in fig. 2A the failure occurred more by bending than shearing. If the failure had occurred by shearing, it would have taken place at each end, where the shearing stress would be naturally the greatest; but the specimen beam broke midway between the point where the shearing stress was greatest and the point where the bending stress was greatest. It seemed quite possible for this reason that where there was shearing stress only, the concrete was sufficiently strong to stand it; where in the middle they had bending stress, the reinforcement was at the point of greatest tension (that was, the bottom of the beam); but half-way between the centre and the support Mr. Fisher's reinforcing rods were in the neutral axis, and therefore would not assist the tension resistance of the beam in any way whatever. In fig. 2, they had at the point where fig. 2A failed two tension rods in the very best position to withstand the tension. He would like to have Mr. Fisher's views on this point, and also as to the value of reinforcement above the neutral axis. Would fig. 2 have been as good, he asked, had the reinforcing rods only been taken up to the neutral axis, instead of right up to the top of the beam?

Mr. W. B. RANDALL (Waltham Cross) remarked that, like other members, he had listened to Mr. Fisher with great interest. He would like to ask whether he had carried out any experiments which would help them in regard to the particular sections of metal to be used in reinforced work. He had had some little experience of indented steel bars, having put up a reservoir holding a considerable quantity of water—more, he might say, for the value of the experiment than for any saving in cost. He found that where clean ballast could be bought at a low rate, and portland cement was also reasonable, the increased cost of the bars and the greatly increased cost of labour in fixing them in position, and the additional time required by the men to well incorporate the concrete with the bars, was a very considerable item; and he did think that often it would pay them to thoroughly consider whether the cost of a 1 foot wall of ordinary concrete would not be actually lower than one of 6 inches in reinforced concrete, when using special bars—whether special bars or expanded metal justified the increased cost they entailed. Another point was that the Local Government Board looked with

very great suspicion on granting loans for reinforced concrete work. Perhaps the author could tell them why the Board were so shy on the subject.

Mr. W. B. Farquhar (Ilford) said the paper would be very helpful to him, as at his works they did a considerable amount of concrete work. The author stated that at Tottenham they had made a roof with clinker ash. With regard to using clinker ash for reinforced concrete work, there had always been a question as to whether it had any effect on the iron or steel. Had the author any information on the subject? Then with reference to the sample Mr. Fisher had shown of the electrolytic action. This action split the concrete; but he would like to ask whether it affected the concrete in strength. Did it spoil the character of the concrete itself?

Mr. J. W. Auchterlonie (Cambridge) asked the author whether he was using reinforced concrete for the piers in the liquor tank illustrated in the paper. He said that, in connection with the covering of an old gasholder tank to store liquor, he had some doubts as to whether the liquor would not act on the reinforcement and possibly destroy it; and, as there would be various tractors going over the concrete to the coke yard, he wanted to know if he would be safe in using reinforced concrete piers.

The Hon. Secretary (Mr. W. E. Price, of Hampton Wick) remarked that, with reference to the point brought forward by Mr. Auchterlonie, he would like to say something (though he did not want to interfere in any way with Mr. Fisher's reply) as to what had been done at his works in the way of covering-in a liquor tank after the manner referred to. He was assured at the time there would be no action of the liquor, and there certainly had been no indication of it. The tank he was speaking of was 40 feet in diameter; and somewhere about thirty years ago it was covered with a concrete roof. This was before the days of reinforcement, and it was covered over the whole distance without reinforcement. The thickness varied from 10 inches at the outside to 14 inches in the centre; and it stayed there for about twenty-five years, showing signs of decay as time went on, until it came to the stage when it was obviously unsafe, and he arranged to replace it. The time at which he had determined to do this was evidently accurate, because just when they proceeded to put on a reinforced top, the existing top fell in. The reinforcement in this case was done with expanded metal. There was in the centre of this 40 feet tank a column; so that the span was about 18 feet, and girders were put across—the expanded metal being put in a suitable position nearer the lower part of the slab. It was haunched off from the lower member of the girder, but it would leave the bottom of the lower member exposed to the action of the liquor. This was got over by putting a small mesh of expanded metal round that member, and covering it with cement, almost neat, before the girders were put in position. As he had said, this was a liquor tank, and the liquor was still in it; so that if the top was to be put on at all, it had to be done from above. Heavy weights went over the top; and, so far as he could see, there was no sign of any action.

Mr. P. P. Channon (Haywards Heath) said that four years ago he was thinking of putting up a small retort-house in reinforced concrete, and using gas-works clinker, and he was warned that it would be fatal to the life of the reinforcement. He had had a steel-framed building standing some years, the upright stanchions being footed in concrete made of gas-works clinker. He opened up half-a-dozen of these, and found the steel girder was perfectly sound, without any trace of corrosion. He then proceeded to put up his small retort-house with clinker concrete reinforced. One advantage he found was that, whereas brick walls would have had to be some 14 inches thick at least at the base, the concrete was only 6 inches thick. He thus saved about 200 superficial feet in area, which was a consideration on a very cramped gas-works. The dimensions of the building were 57 feet by 34 feet; and the total cost came to a good deal less than a brick house was estimated to cost.

Mr. S. B. Chandley (St. Mary Cray) inquired whether polished steel bars should be used. His opinion was that steel-work before being employed for reinforcement should be allowed to rust, so that the surface might become rough and get the concrete to adhere to it.

Mr. D. H. Helps (Reading) asked whether Mr. Fisher had had any experience with reinforced concrete for piling. At Bristol he believed they had driven concrete piles 40 to 50 feet long. Very heavy rams were used. In fact, it was extraordinary what weight could be employed when driving them. He had to put in a foundation for a gasholder tank. The foundation would have to be strengthened; and as the water-line varied, he did not care to use timber piling. He was thinking of using reinforced piling; and therefore he would like to hear what the author had to say on the subject.

Mr. J. H. Cornish (Bridgwater) stated his own experience in the matter of reinforced concrete for foundation work. He said that the works of which he had control were unfortunately situated in the lowest part of the town and on a very poor site. Parts of the soil had at some time or another been dug out for brick-making; and consequently it was all made-ground. Recently he had to move a holder about 90 feet from one site to another; and as soon as they had got to the depth at which they intended starting to build the cast-iron tank, the foundations were simply for the most part nothing but slurry. This, of course, was not a fit condition for a cast-iron tank. He had every intention of piling; but fortunately he got hold of one or two of the reinforcing people in London, and put his case before them, and the result was a scheme of girders and floating raft, somewhat on the same lines as the girder Mr. Fisher had tested. Instead of bars, they used expanded metal. The beams were 18 in. by 12 in., running in every direction across the diameter of the tank at 7 feet centres, and were reinforced with two bars of expanded metal. The slab of concrete was 9 inches over the whole of the foundation work. This had been eminently successful. The tank had not shown the slightest movement since it was put in twelve months ago. He quite agreed that one should not use gas-works material at all for reinforcing work. As to the previous speaker's inquiry about reinforced concrete piles, he would recommend him, before doing anything, to see the "Simplex" system. A steel tube was driven in, and the area of the tube was filled up solid with cement concrete. The steel tube was then withdrawn; the concrete simply taking up the hole made by the tube. It was an extremely successful plan. He had seen many driven. In three or four days they were set, and nothing could be better. He believed he saw a pile 40 feet long driven and left to set in from 15 to 20 minutes. He would like to know why so small a voltage as 2 volts should have split the sample of reinforced concrete shown by the author; and also what the beams used were made of.

Mr. W. J. Liberty (London) pointed out that on the harbour works at Dover they were using concrete piles, about 50 feet long, and also in the sea at Folkestone, in connection with the extension of the Esplanade.

Mr. Fisher, after thanking the members for the kind way in which they had received his paper, remarked that Mr. Botley said he had reduced the depth of floors by one-third through using reinforced concrete. He (the speaker) thought that with modern reinforced construction they would find they could reduce it very much more than this. At the same time, if they were going to use oxide and wet it considerably, they must take some steps to get a waterproof rendering that they would not have for any ordinary requirements. Reference had been made to his mentioning the covering of a tank as being a floor. He was over it every day, and thought of it as being a floor, because it was the floor of their workshops. Allusion had also been made to the panelled walls. He really thought these were good; but at the same time, from the point of view of convenience, 5 feet by 3 feet was rather too big. If he had to do any more of this work, he thought he would make the panels of just such a size that two men could handle them nicely. Mr. Head had raised a theoretical point as to the failure of one of the beams. It was rather a peculiar point. They had in the beam compression at the top and tension at the bottom. They had a vertical shear and they had a horizontal shear; and some people in speaking of shear meant vertical, and others meant horizontal. They had therefore to find out what it was that was being referred to. Fig. 2A failed just about one-third of its length. Mr. Head was quite correct in what he said. In the centre the steel was quite sufficient to resist the tension. At the ends, the concrete was quite sufficient to resist the vertical shear. Just at the point where it failed, the tension bars were in the neutral axis, and were doing nothing; but there was still the horizontal shear at that point. The horizontal shear varied from the centre to the ends. There was nothing just at this point to resist the shear; and the concrete, thus incapable of resisting the shear, failed. In fig. 2 the bars were capable of resisting the horizontal shear at this point. In all cases they would find it was necessary to continue reinforcing above the neutral axis to fully develop the strength of the steel. Mr. Randall had inquired as to the use of particular sections of steel. He would strongly say that for anything like important works it was advisable to use one of the patented systems; and he mentioned the Kahn bar in his paper. But for ordinary work such as he had been describing, which gas engineers had to do almost every day of their lives, he thought special sections should be entirely disregarded. The only precaution necessary in using ordinary round or square bars, was that they should be bent over, so as to give a mechanical bond at the end between the bars and the concrete, in order that they should not slip. This also answered the question of another speaker as to the use of polished bars. He did not think they were at all advisable. In fact, it was better that there should be a film of rust on the bars, but not by any means flakes of rust. On taking out a rusty bar that had been embedded in concrete for years, they would find there was less rust on it than when it was put in. As regarded the permanence of steel in concrete, where old concrete work had been destroyed, there had on occasions been found embedded in it old tools, crowbars, &c. A case occurred in the West Indies where the concrete had been exposed to sea water; and there were found in it, in a state of perfect preservation, tools which had been left there by the convicts who had done the work. Mr. Randall had raised the question of price. Well, he did not think reinforced concrete work was always cheap. It might be cheaper to put up a 1-foot wall of concrete than a 6-inch reinforced one; but at the same time it would not have the same strength. As to Mr. Farquhar's point about clinker ash, this was a matter on which there was a certain amount of discrepancy. In the report of a Committee of the Royal Institute of British Architects, they said in one place that concrete made of clinker ash provided an absolute protection against fire; but in another place they said it should not be used for reinforced work. He thought they recommended it only as a facing for concrete made of the usual ballast or stone. Having used clinker ash concrete a great deal, all he could say was that it was really a good concrete. It would be safe for ordinary work, but not for such important work as covering a tank of 100 feet diameter and then

putting workshops over it. For light work, amply reinforced, he was quite certain there need be no fear in using it—particularly in a place where one could see if any failure occurred. He had demonstrated with the model beams that approaching failure could be seen. As to Mr. Auchterlonie's point, there was a slight difference between heavy girders for a roof, and piers in a tank. At the time they covered in the tank which was illustrated in the paper, they felt the same fear as Mr. Auchterlonie had expressed, with regard to the action of the liquor on reinforced concrete columns, and instead of using concrete columns they put in brick piers. From what he knew of reinforced concrete now, however, he felt sure they would use piers of this material. In the matter of piling, reinforced concrete was very useful. There were many cases in which one could not use "Simplex" piles—for instance, where one had to drive them into water for making a jetty; but there were many cases in which it would no doubt be the best thing to employ. He tried to get some simple foundations put in on this principle, but he found the cost of boring very high. But he would have no hesitation in using the "Simplex" pile, or an ordinary pile made and driven. A very small voltage would cause a fracture in the concrete, if there were sufficient amperage. He had been careful in the experiment to have the reinforcement connected with the positive pole of the battery. If it had been connected with the negative pole, no cracking would have resulted. They must take steps to prevent the action he had shown. The beams were made of a 6 to 1 mixture, of small size, as nearly as possible as would be used in actual work.

SCOTTISH JUNIOR GAS ASSOCIATION.

WESTERN DISTRICT.

A Meeting of the Scottish Junior Gas Association (Western District) was held in the Royal Technical College, Glasgow, on Saturday, Nov. 9—Mr. F. L. MacLaren, of Dumbarton, the President, in the chair—when addresses were given by Mr. John Fraser, of Provan, and Mr. James M'Leod, of Greenock, entitled respectively "Some Practical Observations" and "Thoughts on Purification." The former will be found in last week's "Journal" (p. 511).

The President, in introducing the lecturers, said they had in them two of their Past-Presidents. He would call first of all on Mr. M'Leod.

Mr. M'Leod then read the following address:

THOUGHTS ON PURIFICATION.

It is not my intention to speak either from a deeply chemical or engineering point of view, but simply to look at the general aspects of the problem. You are well aware that, in the early days of gas making, the purifying material was employed in a semi-liquid state. This process gave rise to an offensive, and not readily disposable, bye-product. It was soon seen that under the then conditions this process must be abandoned, and slaked lime purification was introduced; excess of water being avoided. Since those days much thought and skill and careful investigation have been applied to the subject; but, broadly speaking, the process has up till now changed but little. What are these changes? They may be summed up as follows: The nature of the purifying material has changed in most towns from slaked lime to oxide of iron, with exceptions which I shall talk of later. The appreciation of the value of revivification in the purifiers themselves by means of atmospheric oxygen has greatly extended.

The importance of the temperature factor in giving the most complete chemical reaction between the sulphuretted hydrogen in the gas and the purifying material is fully and generally recognized. The importance of slow travel of the gas through the mass is now acknowledged by making the purifiers of ample area for the amount of gas to pass through them; and the necessity of holding or carrying the oxide in such manner as to prevent undue pressure on the mass at the bottom of the layers is being dealt with by one or other of the systems of hurdle grids, which support the oxide in such a way as to render it easily permeable by the entering gas. Last, but not least, the order in which the boxes should be used has been carefully worked out, and now it is recognized that revivification *in situ* is best accomplished when the crude gas containing the necessary proportion of air enters the fresh purifier first and then into the others. The idea underlying this is that the oxygen of the air acts best as a revivifying agent when sulphuretted hydrogen is absent. "But," you may say, "surely these changes which you have indicated nullify your original statement that, broadly speaking, up till now the process has changed but little." Well, I do not think so, because now, as in the early days, we extract the sulphuretted hydrogen from the gas by means of a solid body, and renew that body at admittedly long intervals. But still, in so doing, we come short of the purifying ideal of continuous purification in closed vessels.

PURIFICATION IN CLOSED VESSELS.

Could the freeing of the crude gas of its impurities be effected by a liquid in a closed vessel just as simply as the removal of ammonia is effected in a scrubber by means of water, then one of the dreams of the gas engineer would be realized; but, so far, there is no appearance of this being achieved. The greatest effort in this direction was, of course, that known as the Claus process, which was so brilliant a failure as to be almost a success. So beautiful indeed is the process that one almost wonders if the chemical and engineering skill behind it was ample and sufficient to give it full justice; but I suppose we must take this to be the case. The process, in Mr. Stelfox's own words, is as follows:

> The system proposes to effect complete purification of gas by combining the acid and alkaline impurities to form soluble salts to be taken up by water in a series of scrubbers. This process is going on every day in gas-works as far as the ammonia in the foul gas will carry it; but as the acid impurities are present in a much larger proportion than the alkaline, ammonia must be added in sufficient quantity to effect the necessary combination. This extra supply is to be derived from ammoniacal liquor; and the apparatus is to be divided into two sections, in addition to that for the recovery of sulphur. In the first, the liquor is treated; and the second consists of the vessels in which the gas is to be purified. In the former is included a heater built up in flat sections, each of which contains a steam-chamber provided with steam from the main supply, which is regulated at will by means of a tap. The liquor, which is introduced at the top, is made to run in a tortuous course over the surface of each of these trays by means of baffles; and on reaching the opposite end of the tray from that at which it enters, it overflows on to the next plate, and so continues to the bottom of the vessel. The lower trays are kept at 190° to 200° Fahr., at which temperature a large proportion of the carbonic acid and sulphuretted hydrogen is driven off as gas and passed on to the sulphur-recovery plant. The remaining liquor is therefore principally caustic ammonia. This is treated in a still, and the ammonia gas is taken, after cooling, to the purifying vessels, where it is mixed with the foul gas. The resultant salts being removed in the scrubbers, the gas is purified, and the strong liquor formed is returned to be again treated in the heater; so that, theoretically, there is no loss of ammonia. The gases driven off in the heater are passed through a scrubber and catch tower on their way to the sulphur-recovery chambers; so that any ammonia passing away is arrested and returned to the system.

This is a brief description of the remarkable process by one who, with undaunted courage, carried through years of experiment with it and finally gave to the world, with equal courage, a record of its practical failure under working conditions. A process, however, which could work successfully for three months on end, as this did, has in it the possibility of working continuously. Every one should read the record of Mr. Stelfox's work in the "Journal of Gas Lighting" for June 29, 1897, and no one who does so will but feel he has been stimulated and helped by so doing.

In the Technical Press recently there appeared a paper by J. G. O'Neill, of Geneva (N.Y.), on the "Continuous Purification of Coal Gas with Weak Ammoniacal Liquor."* This process, however, is apparently only a partial one, ordinary purifiers being still required, as all the sulphuretted hydrogen is not removed by the weak liquor. Mr. O'Neill says "any advance in the art of gas purification must have for its basis simplicity of operation;" and one can heartily agree with him in this. But surely his method of adding coil and tubular coolers, in addition to existing purifier-boxes, is not achieving this desirable end, although he seems to show conclusively that he can very much reduce the work done by the purifying-boxes by these means, and so thereby avoid extending costly oxide purifying area to meet increasing output. In his process, sulphuretted hydrogen, cyanogen, and carbonic acid are absorbed from the unpurified coal gas by means of a weak ammonia solution prepared in a crude ammonia concentrator. The amount of weak liquor feeding into the still is increased; and this increase of liquor is drawn off near the outlet of the first ring, the contents of which have been subjected to the action of steam containing a high percentage of ammonia vapour. The hot liquor drawn from this ring is cooled to at least 30° C. and pumped into the first of two scrubbers, taking the place of the usual gas liquor; and this prepared liquor is the effective agent in reducing the sulphuretted hydrogen. Mr. O'Neill states that if "ordinary gas liquor is substituted for the special liquor in the first scrubber, there is practically no increase of sulphuretted hydrogen in the gas liquor or decrease of sulphuretted hydrogen in the gas.

It is worth noting particularly that the ammonia loss in this process was *nil;* and this is sufficiently striking in comparison with the Hills and the Claus processes. The loss of ammonia in Belfast was very great indeed. Before passing from this, one might say that the process closely resembles that of Holgate; the essential difference being the preparation of the special liquor. Does this Junior body possess a member who will ultimately show us how to purify coal gas by liquids in closed vessels and on a commercial basis? It is a great end, and one worth striving after. Even if some one may say that modern methods of oxide purification have been so improved that the cost has been reduced to a very low figure, still, which of us would not select a gracefully proportional and elegant machine to do a certain work rather than a clumsy and bulky one if we had the choice? The modern large purifying vessels cannot be regarded as beautiful, and danger is always near them.

In the "Journal of Gas Lighting" for Nov. 5, there is described yet another process for the purification of coal gas by ammonia in closed vessels. The scheme is that of Messrs. W. C. Holmes and Co., and is described by Mr. Howell, who seems to

* See "Journal," Oct. 29, p. 373.

endorse something of what I said as to the Claus process as tried at Belfast, for he says the Claus and Hills processes failed for, among others, the following reasons :

1.—Plant improperly designed and faulty in construction.
2.—Inadequate capacity.
3.—Large leakage of ammonia due to the great number of pumps required.

The strong points about the plant are that no pumps are used and no loss of ammonia is incurred, and also that nearly the whole of the circulating liquor is not required to be pumped, but gravitates through the plant. The drawing, however, given in the "JOURNAL," shows rather a cumbersome and somewhat complicated looking plant. There are no fewer than four scrubbers indicated on it, not to mention other plant. The cost must be heavy, and the ground space occupied is considerable. The plant has yet to be put into operation; but, on the whole, it looks efficient, and might be expected to do the necessary work well.

THE BURKHEISER PROCESS.

Turning from the ideal method of purification by liquid in closed vessels, which may possibly remain only an ideal, let us look for an instant at a system from which much has been expected—the Burkheiser process. At first I, in common with most of us, was greatly taken with this process; but I cannot say that I now hold quite such high views of it. The process consists in the use, in the first instance, of a specially-prepared granular oxide of iron, in the set of purifiers, the first of which, when it has become sulphided, is thrown out of the series and blown through with air, a high temperature is developed, and sulphur dioxide is produced. This dioxide passes into a scrubber containing ammonia liquor, and forms the acid sulphite, or bisulphite of ammonia. This solution of bisulphite is pumped into a second tank, from which it is fed into a scrubber to free the gas from ammonia, and becomes half neutral. From the scrubber the liquor flows into a tank, from which it is pumped into a precipitating tank, which takes the place of the usual lead-lined saturator. The gas, rich in ammonia, bubbles through this, and a mixture of sulphate and sulphite of ammonia falls out of solution, and may be removed in any of the usual ways.

The neutral solution of sulphite is again pumped into the air-scrubber, where it is acidified, as indicated by the sulphur dioxide from the revivifying oxide; and this cycle of operations goes on. The ordinary virgin liquor from the condensers is distilled as usual with lime, and the ammonia obtained is passed into the condensers and goes forward with the crude gas. This, in brief, is the process; and it is claimed in the translation of the German print I have here [I have also the German Patent Office drawings, if any one wants to look at them] to possess about a dozen separate and distinct advantages. These are as follows:

Advantages.

1.—The entire elimination of bought sulphuric acid.
2.—The conversion of the cyanide absorbed by the oxide into ammonia, which is recovered.
3.—Large saving in capital cost owing to small size of plant.
4.—No lead work is employed.
5.—The plant is self-contained and therefore independent of any acid factory or distiller.
6.—The nuisance of dealing with the foul gases from sulphate plants is avoided.
7.—The quantity of waste liquor from the ammonia still is very considerably reduced.
8.—All gas-works having pumping and exhausting power will now be able to make sulphate.
9.—The storage area for gas liquor can be considerably reduced.
10.—No changing required, only a making-up of wastage.
11.—The sulphate of ammonia obtained is nearly neutral, and much less damage to bags, &c., occurs.
12.—On account of the nature of the scrubbing liquor, the whole of the ammonia in the gas is recovered and is independent of varying temperatures.

The above are the advantages. What are the disadvantages?

Disadvantages.

1.—Very much more skilled supervision would be necessary.
2.—Blowing air through the sulphided mass to produce sulphur dioxide means the development of a very high temperature, and is risky, even although the box is valved off from the gas supply.
3.—There is a continual wastage of oxide due to the formation of sulphate of iron, which must be washed out of the oxide and into the drains, and, in addition to sulphate dissolved, there would possibly be a good deal of oxide carried away mechanically by the washing.
4.—It is, on the whole, more complicated than the present methods.

It should also be mentioned that it is a mixture of sulphite and sulphate that is produced; but it is claimed to be quite as good as pure sulphate for manurial purposes.

OTHER PROCESSES.

There is, as was indicated by Mr. Doig Gibb, in a recent address, a process in successful use in London just now for gas purification. This method is principally directed towards reducing the total sulphur found in the purified gas by converting the CS_2 in the crude gas, in which form the bulk of the sulphur other than sulphuretted hydrogen exists, into the latter body, when it can then be absorbed by the oxide purifiers. It has been shown that certain bodies, heated in the presence of bisulphide of carbon, had the power to convert that body into sulphuretted hydrogen; and advantage is taken of this fact in Evans's process.

In an interesting paper which appeared lately, an investigator showed that even a moderate degree of heat applied to an iron supply pipe was sufficient to reduce some of the bisulphide of carbon in the gas passing through the pipe and to cause a dirty test to appear in gas which was free from sulphuretted hydrogen before passing through the pipe. In Evans's process, the gas is preheated before passing through the contact mass, which is fire-brick impregnated with a nickel salt. The gas is preheated by passing through a series of tubes contained in a furnace, and then through the container, which is a wider tube in the same furnace; the container holding the contact or catalytic mass. The bisulphide of carbon is almost wholly converted to sulphuretted hydrogen, and the total sulphur in the pure gas thereby reduced to a very low figure. It might be said of this process that nickel salts are expensive; and it would be interesting to know what the wastage came to. It might also be asked if there is no danger of the formation of nickel carbonyl due to the action of the carbon monoxide in the gas, or is the nickel salt such that the carbon monoxide does not act on it, or is the temperature not high enough to form the nickel carbonyl? The Mond nickel process depends on the formation of this volatile nickel carbonyl. The gas from Scotch coals as a rule, however, does not contain so much sulphur as English gas; and therefore this reduction of the total sulphur does not so nearly concern us. In a Presidential Address to this Association, I pointed out that the average English gas liquor contained fully double the amount of total sulphur that the liquor at the Provan Gas-Works contained.

AIR REVIVIFICATION OF LIME.

A development has taken place at several works in the use of air for the revivification of lime, where this is used for purification. At first it was looked on with a little suspicion; but several Scottish managers of my acquaintance are successfully using it. The mechanism of the process is perhaps as follows: Sulphide of calcium or hydroxyhydrosulphide is first formed by the action of the sulphuretted hydrogen on the slaked lime, and this body, in the presence of carbonic acid and oxygen, gives up free sulphur in the mass. This may rise to 6 or 10 per cent., as mentioned by Hoskins. The percentage of carbonic acid is high in Scotch coals (in my own case, averaging for the last month $3\frac{1}{2}$ per cent. of volume—at Provan I found it from 2478 to 3647 grains per 100 cubic feet). This must rapidly produce carbonate of calcium, which is inactive to sulphuretted hydrogen; and I must say it is difficult to understand how revivification *in situ* can go on for the long periods I am told it does.

It would be easy to explain that where the lime is taken from the boxes and spread out a physical change takes place—that is, the lime is broken up and a fresh surface of hydrated oxide exposed, which can again render service in taking up sulphuretted hydrogen. It would be interesting if some one using this process would give us more complete details of it, and the theories underlying it. The lime treated thus is quite inoffensive when taken from the boxes.

THE PATERSON PROCESS OF LIMING.

Before leaving lime, permit me to refer to Paterson's liming process. This has also for its object the reduction of the total sulphur in the gas. The idea has been known for many years; but for a long time, until Messrs. Paterson and Twycross took it up, it has lain in abeyance. The crude and irregular methods of applying the lime have been abandoned, and carefully ground lime is now mixed with the coal and steam blown into the mass to cause the lime to adhere. The patent specification appears in the "JOURNAL OF GAS LIGHTING" for May 23, 1911; and I need not describe it. Mr. Paterson says that they were greatly troubled with excess of sulphur compounds in the gas after they gave up lime purification in 1907, and he began experiments with limed coal for reducing the sulphur. He is now able to keep down the sulphur to 20 grains per 100 cubic feet, using less than 2 per cent. of lime calculated from the weight of coal used. There are, he says, collateral advantages arising from the liming process, such as greater yields of gas and ammonia, freedom from stopped ascension pipes, less carbon, and no lime is visible in the coke. The process, however, does not immediately concern Scotch coal users, as the amount of sulphur barely reaches 20 grains per 100 cubic feet of the pure gas, even with oxide alone as purifying agent. It is not easy to explain just why there should be fewer stopped pipes with this process. The increased yield of gas mentioned is presumably dependent on this factor, and why there should be less carbon is no more clear.

Having glanced at the various processes briefly, it might be asked, until the millennium of purification you have indicated arrives, what are you doing yourself? Well, in the new purifying-house under construction at Greenock, I am taking advantage of all the modern modifications of oxide purification, as indicated at the opening of this address. The purifiers being put down are six in number—40 ft. by 30 ft. by 6 ft. deep, with 24-inch connections. They are on Green's principle, on the overhead system, with revivifying floors above; an elevator being provided on ground level to raise the oxide to the upper floor. Spencer hurdle grids are used, and provision is made for warming the entering

gas. The gas enters at the top of the boxes and leaves at the bottom. These boxes embody, I think, all that is known about the best methods of oxide purification, and, in conjunction with a suitable system of rotation, should give satisfactory results. You have in what has been said, and perhaps more in what has been unsaid, a wide field for discussion; and as a Past-President of the Association, and as much a student of the subject as any of you, I hope you will criticize freely.

Discussion.

Mr. JOHN WILSON (Falkirk) said he remarked in Mr. M'Leod's new purifying-house that the gas was entering at the top. Why did he do so? Personally, he was of opinion that, if one desired to work the purifying on the backward rotation method, it was essential that one did put in the gas at the top, because if one put it in at the bottom the revivification that went on swelled the body of oxide to such an extent that one had to clear out the oxide. If, on the other hand, one did not deal with the backward method, one could quite well put the gas in at the bottom, because this evil did not then exist. He noticed Mr. M'Leod was making preparations for the warming of the gas. He thought this was a good thing. They ran a line of piping round the bottom of their purifying boxes, and then allowed a little steam to work through—just enough to keep them warm. They found this very useful in the cold weather.

Mr. JOHN FRASER said that, as most of them knew, they were introducing at Provan just now oxide for purification purposes. Experience would come later; but things in this respect were not very rosy. However, from Mr. M'Leod's paper he had culled a few useful things.

Mr. DAVID FULTON thought that the paper was very appropriate at the moment, as the subject of purification was becoming of urgent importance, if not in Scotland, in England. They certainly wanted to obviate the use of lime. If this process could be brought to a successful conclusion, it would be greatly appreciated by the English gas managers. With regard to the revivification of lime, it was a thing of which he had his doubts. If the lime was put into the box in the first instance in a finely-divided state, it seemed to him no revivification worth mentioning could take place.

Mr. S. B. LANGLANDS (Glasgow) wished Mr. M'Leod, in his reply, to deal with the efficacy of the old method of purification, which had not received the attention it might have had. In lime purification, he thought the whole question was one of the proper slaking of the lime at the outset. There was not so much in the revivification of the lime as in the question of doing something at the outset. He would like further information on the various types of oxide in use, and on the composition of oxide generally. He was glad to hear Mr. M'Leod pay a tribute to Mr. Stelfox, of Belfast. One could only admire the courage of that gentleman, when one thought of the £20,000 he spent. He had had the pleasure of working many times with Mr. Stelfox; and it might not seem out of place to say he had never met a more courageous engineer in his life. The difficulties in the way of his work at the Ormeau Park works were almost insurmountable. He built his purifiers tier upon tier into the air, because he could not get land. With regard to the Burkheiser process, he had seen the plant at work in Berlin. What struck him was the involvedness of the process; but there certainly were tremendous possibilities in it.

Mr. M'LEOD remarked that Mr. Wilson had answered his own question just as well as he could. By entering the gas at the top, it came into the oxide with a considerable amount of moisture, and one got this moisture right down through the mass. Having an even distribution of the moisture, condensing in the mass, one prevented the caking so objectionable in the bottom of the oxide. As to Mr. Fraser, when he turned completely to oxide he would wonder why he had not done so before. The evidence was absolute and conclusive, and managers were getting good results. With regard to Mr. Langlands' remarks, there was a great deal to be said of milk of lime. He thought the mechanical difficulty was the real trouble. After trying Irish oxide, Dutch oxide, and Lux purifying material, he had abandoned Irish oxide—using Dutch and a little Lux. Mr. Langlands' admiration for Mr. Stelfox was no greater than his own; and he would strongly advise them all to read the paper referred to in his address. It was one of the most stimulating papers ever written.

DISCUSSION ON MR. FRASER'S ADDRESS.

[SEE ANTE, p. 511.]

Mr. M'LEOD said he was particularly interested in the way Mr. Fraser had overcome the difficulty of fluctuating steam pressure at the producers. This difficulty had presented itself at Greenock, where he had installed a governor to give a steady pressure. It was interesting, too, to learn how accurately Mr. Fraser had been able at Provan to control the lighting-up of the producers. He was sure it would have been initially a work of extreme danger. He was glad they had reached at Provan an absolute fixity of method in this respect. Regarding naphthalene, his experience was pretty extensive, he was sorry to say. He was in the gas industry for some 16 or 17 years before he ever saw naphthalene; but within the last year or two he had seen more of it than he had any wish to. It was worrying when one got a pipe clear for an irate consumer, to find him back again in a month or two complaining about the quality of the gas. It was interesting to know how the naphthalene difficulty had been overcome at Provan. Any such method had absolutely failed with him. Naphthalene was a very curious substance, and seemingly no treatment would cure the difficulty in any two works. In spite of keeping the gas at a uniform temperature leaving the condensers, washing the gas with a solvent oil, &c., he had still got some naphthalene. It showed that the problem was one of extreme difficulty. He had one holder inlet choked up. He simply poured a barrel of benzol into the hole, running in water to float the benzol to the top, and then pumped. The naphthalene deposit had grown until there was only left a free passage of 8 inches.

Mr. GEORGE BRAIDWOOD (Coatbridge), speaking of Mr. Fraser's assertion that profits could be made or lost in the retort-house, said this was undoubtedly the case. While the fact was readily admitted by most engineers, it was apt to be overlooked in these days of advertising and the pushing of the commercial side of the business. No amount of extra sales would compensate for the profits lost through bad carbonizing, poor heats, heavy seals, and carboned-up retorts. Mr. Fraser had probably more experience of the working of the Arrol-Foulis machines than any other man in Scotland. It was interesting to know that a change in the way of the charge should lead to an alteration in the coal feed which obviously would give far better carbonizing results—proving that necessity is always the mother of invention. On the subject of heats, the conditions of having a supply of gas from outside producers, of constant composition, for the heating of the retort-bench could be very thoroughly grasped by those who were responsible for the working of internal producers, all with independent steam supply, and being cleared and attended to by sometimes not very careful men. While Mr. Fraser was justly proud of the heats which he could maintain, he (Mr. Braidwood) was not quite sure that he would care to carbonize at a temperature of 2200° Fahr. Looking at it from a balance-sheet point of view, he was afraid the loss of tar, ammonia, and fuel—not to speak of wages for pipe-jumpers, cost of naphthalene solvene, and extra purifiers—would not be compensated for by an increased yield of gas and cyanogen. He was not quite sure how Mr. Fraser arranged his steam supply and primary air. The only other point which appealed to him was the length of time necessary in getting a new bench or oven into action.

Mr. T. CARMICHAEL (Dawsholm) explained that at Dawsholm they did not generally interfere with the primary or secondary air dampers for fluctuation of vacuum in the main flue due to atmospheric conditions. They had a King's gauge connected up to the main flue, which registered the pull of the settings; and by means of a readily adjustable damper at the foot of the chimney, they kept this pull a constant quantity, and had no difficulty in maintaining a uniform development of heat in the settings. They had the same difficulty with regard to the tar and liquor weir clogging up; and they found them to work splendidly on the vertical retort mains, which only required to be flushed out once a fortnight.

Mr. FULTON was specially interested in the method of regulating the pressure of the gas from the producers to the ovens. The whole success of the firing by outside producers, he said, depended upon this steady pressure.

Mr. WILSON thought it was a good thing that Mr. Fraser kept men picking over the coal coming in, because it was a moral influence upon the colliery people—making them more careful as to the class of material they sent. He had listened with pleasure to the remarks upon the lighting-up of the producers. Mr. Fraser spoke about one-eighth part and ¼ inch. The attention to minute detail in this respect went for high-class results. Yet how often at the present time they found that the measurements were taken in finger-breadths and hand-breadths. Mr. M'Leod had mentioned on the naphthalene difficulty that he used a barrel of benzol. Well, if anybody else was anticipating doing this, he would advise him to see his valves were tight. He did it once, and the water used found its way into the main, choking it.

Mr. FRASER said, with reference to the lighting of the producers, it was really at one time looked upon as a very difficult and dangerous matter. As to the naphthalene difficulty, he might say that he had been addressed by members of the Street-Mains Department, who told him that the eastern district of Glasgow was the only one free from naphthalene. This was the only district they supplied. He knew that when they were troubled it was the inlet and outlet of their holder. One was completely blocked, and remained so for three days. They first put in some solvene, and then resorted to the use of steam. With a combination of the solvene and steam, they got it out in the course of three days. Referring to primary air, he said that when they started the plant at Provan they had elaborate meters for measuring the air. All these meters were failures. The only way was by observation and patience. He might say a word on the slow bringing up of the heats. During the fog that happened two years ago, they lit up a bench on the Tuesday, and it was making gas on the Thursday. He considered that, if the weight of their charge exceeded 3 cwt., the results went back.

Scottish Junior Gas Association (Eastern District).—On Saturday next, the quarterly meeting of the Association will be held in the Masonic Hall, Kirkcaldy, when papers will be read by Mr. J. M'Millan, on "Ups and Downs of a Manager in a Small Gas-Works," and by Mr. R. Scott, on "Damage Done to Gas-Mains through Subsidences." At the close of the meeting, tea will be provided by the kindness of Mr. J. Kincaid, of Kirkcaldy.

RETORT-HOUSE FURNACE CHARGING, AND OTHER DETAILS.

By G. M. GILL, Commercial Gas Company, Wapping.

[A Paper presented to the Southern District Association of Gas Engineers and Managers, Nov. 14.]

I was invited by the President to read a paper at this meeting; and he suggested that I should give you details of the mechanical furnace charger that has been working at Wapping for about a year. He also suggested that I should include in the paper any points connected with retort-house work likely to be of interest. This I have endeavoured to do in this short contribution. I will first describe the machine, concluding with particulars of a few arrangements that have been found to be useful in carrying out certain details in our retort-house work.

THE FURNACE CHARGER.*

The object of the machine is to charge the furnaces with the hot coke as it comes from the retorts—an operation usually attended with much physical exertion, and which has, so far as I am aware, always been done by manual labour. In installing a machine, we hoped to dispense entirely with this arduous work, to fill the furnaces more quickly, and, by use of the machine, to enable the "firing draw" to be carried out by the same number of men as are required in the "ordinary draw." In some works, this latter point may be of no importance; but in our case, it has always been a difficult matter to so arrange the work that sufficient men should be available for filling the furnaces. It is often the case that the number of men required in a shift must be based on the number required during the heaviest draw.

With many types of settings, the furnace is situated right under the retorts, projecting but little beyond the front wall; and in such cases the machine will be found to be of special benefit. In the case of the machine at Wapping, our expectations have been more than realized; the work is done more quickly, no more men are required in the firing draw than in the ordinary draw, and there is no hard work whatever involved in filling the furnaces. At the Wapping works, the machine is attached to the side of the coke discharger, and is driven by hydraulic power. The "poker" consists of a rod 9 ft. long by 3 in. by $\frac{5}{8}$ in., with fish-tailed head, and is actuated by two rams, 3 ft. 10 in. long by $1\frac{1}{2}$ in. diameter, attached by means of chains to a slipper fixed at the back end of the rod. One ram is used for the outward stroke and the other for the backward stroke. The length of the stroke is 6 feet, which allows the rod to project into the furnace for a distance of 3 ft. 3 in. This was found to be enough in the case in question, as the machine drives the coke into the furnace with sufficient force to throw it to the back. The slipper runs to and fro on a 5 in. by 3 in. joist; while the rod is guided by a small roller attached to the front end of the joist. A valve admits pressure alternately to each ram; and in this way the stroke can be varied as desired by the driver.

In front of the coke discharger on the furnace side, there is fitted a receptacle of sufficient size to hold the coke from one retort. The head of the poker is situated at the bottom of this receptacle; while fixed above it is a plate, from under which the poker works to and fro. At the back end of the machine there is placed a spring buffer, which reduces to a minimum the shock upon each backward stroke. The time occupied in charging a furnace with 9 cwt. of coke is about 25 seconds; while the furnaces on the eight settings of ten retorts, on which it is at present working, are all completed in eight minutes—from the time the first is commenced until the eighth is finished.

The cost of working the machine is very small, as it is only actually at work for a few minutes in a long draw; while during the remainder of the time the driver is available for opening the doors, augering the pipes, or replacing the furnaces doors. In our case, the foreman usually works the machine. It is speedy in working, and will do forty complete strokes in a minute. As to the saving to be effected by its use, I cannot give any figures, as the machine was started at the same time as single furnaces were adopted in place of double furnaces for each "through" setting. The saving is undoubtedly substantial, and the machine was popular with the stokers from the first; while I am sure that they would be very loath to again go back to the old method.

The wear and tear during the first year's working amounted to less than £5 in all. We have worn out six poker rods in the course of the year; but otherwise no parts have had to be renewed. Apart from this, the wear and tear has been infinitesimal. Against this, there should be placed the wear and tear of the tools used previously for handwork. With such a machine in use, the furnaces may be filled at more frequent intervals, if desired, at no extra expense, and without putting any additional work on the men. In our case, the furnaces measure 2 ft. 10 in. by 4 ft. 10 in. on the grate, and are 7 ft. 6 in. in depth from the fire-bar level to the springing of the furnace arch. We make a practice of filling them every four hours.

The machine in use at the Wapping works is shown below. In this retort-house, Arrol-Foulis charging machines and Williams-M'Phee coke pushers are provided on each side of the house; so that coke may be discharged on either side. As there are single furnaces to each setting, the coke pusher on the furnace side is fitted

* An illustrated description of this plant appeared in the "JOURNAL" for May 7 last, p. 353.

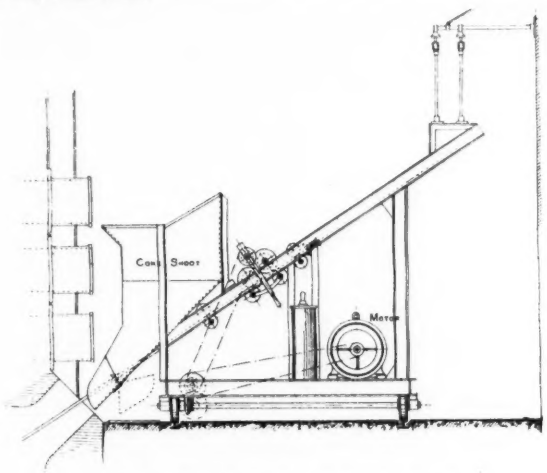


Fig. 1.—Electrically-Driven Furnace Poker.

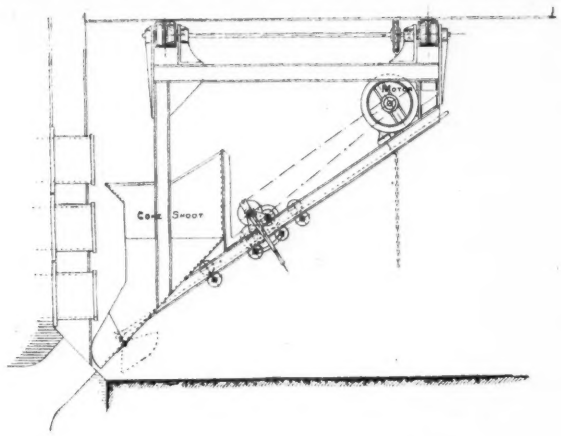


Fig. 2.—Furnace Poker, Suspended Type.

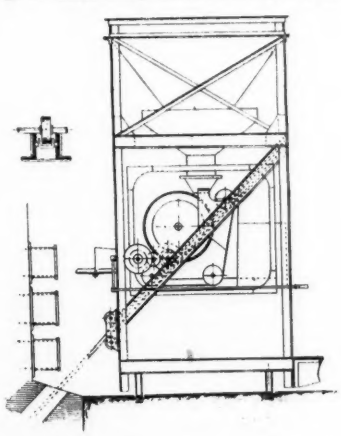


Fig. 3. Furnace Poker, attached to the Existing Stoking Machine.

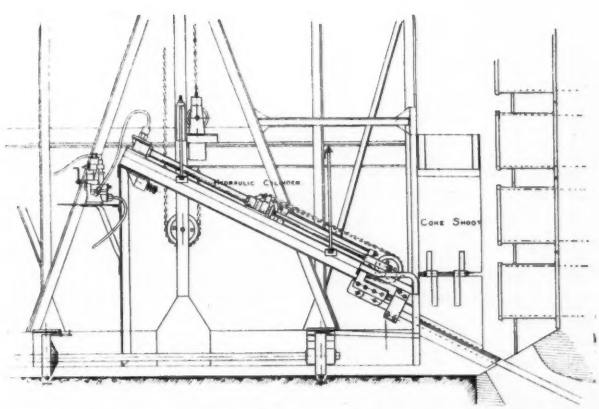


Fig. 4.—Hydraulic Furnace Poker attached to the Existing Machine.

with the furnace charging machine. In cases where the stoking machines are placed on one side only, it would be necessary to fit the machine on the opposite side—adapting it to either of the methods shown in figs. 1 and 2. On the other hand, should any stoking machine be used on the furnace side, it would usually be more convenient to attach the furnace charger to the side of the existing machine.

Fig. 1 represents the general arrangement of a machine now under construction for use in conjunction with De Brouwer stoking machinery. It will be seen that the machine is electrically driven; a small motor and controller being arranged on the frame. By means of a clutch arrangement, the same motor traverses the machine in front of the retorts. The arrangement for operating the poking bar is exceedingly simple and efficient—any length of stroke being obtainable at will by a simple movement of the hand lever. The operator stands well back, and is shielded from the heat by the back of the shoot. Suitable sight holes are provided, so that he can watch the operation of the poker. In this particular case, it has been found necessary to hinge the nose of the shoot, in order to clear the buckstays. An existing 3 H.P. motor is to be used.

Fig. 2 shows a somewhat similar arrangement; but in this case the machine is suspended from a carriage travelling on two lines of overhead track. The travelling in front of the bench is performed by means of hand gear; the travelling wheels being fitted with roller bearings for ease of movement.

Fig. 3 shows the poker arranged on the side of the De Brouwer projector machine. This can only be done in case the discharger is on the opposite side; but it makes a simple and efficient arrangement.

The machines shown in figs. 1 and 2 can be fitted with a platform for scurfing, and the shoot can also be arranged to direct the coke on to the conveyor, which greatly minimizes the breakage due to the fall of the coke from the retort to the conveyor.

Hose-Pipe Carrier.

The second part of my paper consists of a description of some of the many details of retort-house work which at times prove troublesome.

In retort-houses fitted with hydraulic or compressed air stoking machines, it is customary to employ some form of travelling carrier to support the flexible pipe distributing the power. Until five years ago, we used to allow the hose-pipes to drag along the ground; but this is undoubtedly a bad practice, and accounts for a good deal of wear and tear which could be saved. With a hose-pipe dragging on the ground, the dampness and grit combine to prematurely destroy the material. A simple and efficient means of carrying the hose-pipe may be obtained by stretching a wire rope (in our case, one of $\frac{3}{8}$-inch diameter for a distance of 170 feet) from one end to the other of the retort-house. An eye-bolt, of $1\frac{1}{4}$ inches diameter, screwed for a distance of 12 inches, was fitted into each end wall; the wire rope by this means being drawn tight. On this rope runs a small single wheel, to which is attached a swivel and wooden block, on which the hose rests. We have found that a few links of chain make a suitable swivel; while the wooden block is curved on the top to make a suitable support for the hose which is temporarily fixed to the block. This arrangement is very inexpensive; and I think I am right in saying that it has not cost us a penny piece to keep it in repair during the five years it has been in use at Wapping. Added to this, it moves along without any noise and without effort. The details of this arrangement are shown in fig. 5.

Tar-Tower Arrangements.

In working our tar-towers, we have found an advantage in so arranging that all the liquor condensed in the foul main or over-

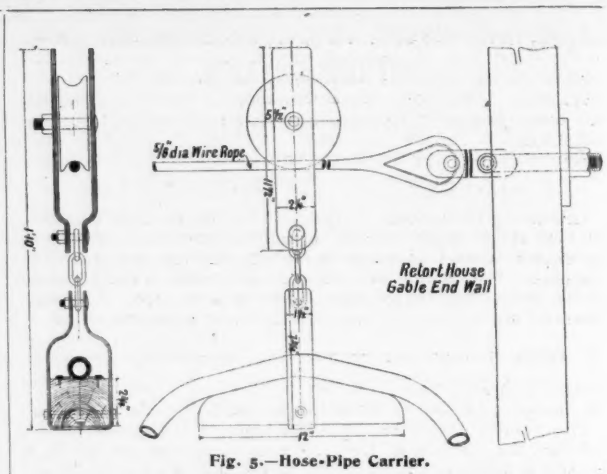


Fig. 5.—Hose-Pipe Carrier.

flowing from the hydraulic mains or tar-towers is caused to flow into a tank situated at a convenient level in the retort-house. This liquor is pumped into an upper tank, which, in turn, supplies the tar-towers and hydraulic mains with liquor. There is, of course, a surplus quantity of liquor which overflows into the storage well; but, generally speaking, the same liquor is kept in continual circulation. Should tanks not be provided, the hot liquor condensed in the retort-house will, if allowed to run into the well, soon raise the temperature of the liquor in store, and result in loss of ammonia. For this reason, we have found it advisable to keep the hot liquor for continual use in the retort-house, only allowing the actual make to run away into the well. In the lower tank is fixed an overflow pipe, through which all surplus liquor flows into the well. In our case, this is a 2-inch wrought-iron pipe laid above ground from the retort-house to the well; and we find that the liquor is thereby cooled in its passage to the well. By this means, we have been able to keep our liquor in store at a temperature very little above that of the atmosphere.

The pump used for the purpose at Wapping has an important duty, and that is to flush-out all the tar outlets from the hydraulic mains. Each section—and in our case there are no more than five hydraulic mains to one tower—has a connection from the delivery of the pump; and it is our regular practice to pump a quantity of liquor at considerable pressure through the tar outlet pipe, with the cocks on each hydraulic main either open or shut. This method quickly clears any obstructions, especially as each section is treated in this way every eight hours. I know of no more effective method of keeping the hydraulic mains and tar outlet pipes in "apple-pie" order.

Fig. 6 shows the lower tank, which receives all the liquor that is condensed in the retort-house, and also the upper tank to which this liquor is pumped. Each hydraulic main has a 3-inch outlet fitted with a cock that in ordinary working is always left open. The tar-pipe is 4 inches in size, and is laid level to the tower. The connections are so arranged that the pump may be used to force liquor from the lower tank through the 4-inch tar-pipe. By carrying out this operation at regular intervals, our tar-pipes are kept in a perfectly clear condition, even though laid without any fall to the tower. The remainder of the details are not shown, as they are similar to those usually adopted.

Packing of Hydraulic Coke-Pushers.

The packing of the glands in the various types of hydraulic

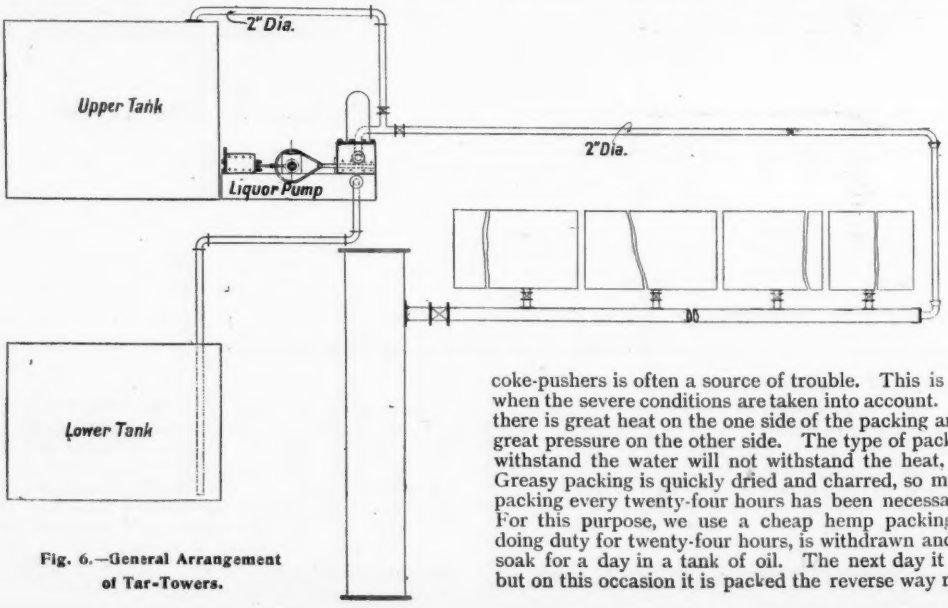


Fig. 6.—General Arrangement of Tar-Towers.

coke-pushers is often a source of trouble. This is not surprising when the severe conditions are taken into account. In such cases there is great heat on the one side of the packing and water under great pressure on the other side. The type of packing which will withstand the water will not withstand the heat, and *vice versâ*. Greasy packing is quickly dried and charred, so much so that repacking every twenty-four hours has been necessary in our case. For this purpose, we use a cheap hemp packing, which, after doing duty for twenty-four hours, is withdrawn and is allowed to soak for a day in a tank of oil. The next day it is again used; but on this occasion it is packed the reverse way round. On the

following day, it is again turned on to its side, to be again reversed on the fourth day. In this way, all four sides of the packing are used, while the alternate soakings in oil provide the ram with lubrication. Since this method was adopted, the cost of packing has been reduced by four times, and the rams are kept in excellent condition, and are fully capable of doing a hard year's work before requiring re-turning in the lathe.

Stoppers for De Brouwer Charging Machines.

In working twelve-hour charges with our De Brouwer machine, we were at first much troubled by noticing how black the ends of the charges always appeared on the side furthest away from the machine. The charges were virtually full; while about 6 inches of the end of the charge was always uncarbonized. This was, however, practically cured as soon as we changed the shape of the stopper from |——— to \——— by which means the heated part of the retort above the sloping portion of the charge is enabled to carbonize the end of the charge.

Fig. 7 shows two forms of coal-stoppers. In the case of the old type, the coal—when the stopper is withdrawn—is left in a banked-up shape as shown. It is curious that this should be so; but I attribute it to the slightly sticky state in which the coal

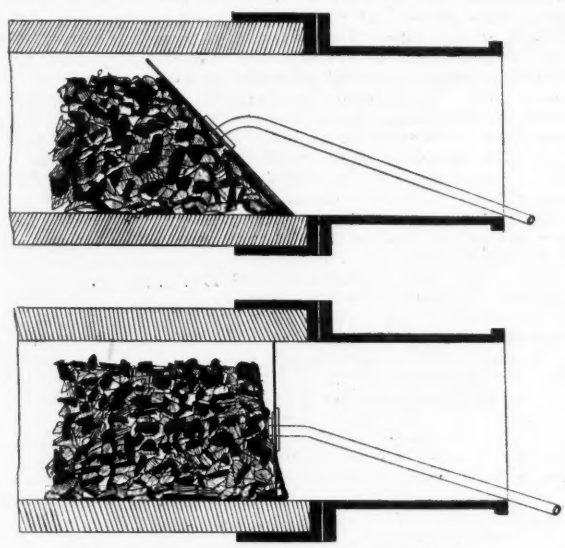


Fig. 7.—Coal-Stopper for the De Brouwer Machine.

reaches the stopper after passing through 20 feet of heated retort. This being so, the end of the charge facing the iron mouthpiece is cooled, with the result that the penetration of heat from the top and bottom of the retort is counteracted by the cooling action of the mouthpiece. The end of the charge could not be properly carbonized under these conditions. With the new type of stopper, the coal at the end of the charge is caused to lie at a slant, and is thus carbonized by the radiated heat from the top of the retort.

Radiation of Heat from Retort-Settings.

We have for some time attempted to prevent as much as possible the radiation of heat from the retort-settings. On the front walls of the settings we used to plaster a 2-inch layer of non-conducting composition. This was effective while it stayed on; but even when reinforced with wire netting it often peeled off, and constantly required repairs. We then built a 2-inch layer into the front wall, which was made of 11-inch thickness, composed of two separate 4½-inch walls, tied together here and there, with non-conducting composition built in between. We found that this method, while efficient for retaining the heat in the setting, prevented the heat from penetrating the outside 6 inches or so of the retorts, with the consequence that the mouthpiece had the appearance of being dull and tarry. Since coming to this conclusion, we have had the material supplied in the form of bricks, 9 in. by 2½ in. by 2 in., which have been built outside the front 9-inch wall, but tied to it every few courses, and built flush with the flanges of the mouthpieces. These bricks are not very hard when supplied, and may be cut with a tenon saw; but when raised to a working heat, they set as hard as an ordinary brick. We have great hopes that this method will enable the mouthpieces to be well heated, and will at the same time prevent much radiation of heat.

Fig. 8 shows our method of minimizing the radiation of heat from the retort settings. In cases where non-conducting material is placed inside the front wall, it is undoubtedly the case that the heat will penetrate as far as the material; but beyond it the temperature of the brickwork will be comparatively low. It follows that the retort where built into the front wall will be heated to a similar extent as the part of the wall that covers it. Thus, if 6 inches of the wall is comparatively cool, there is no doubt that a like amount of the retort will also be cool. With non-conducting material built into a front wall, it is inevitable that about 6 inches of the outer side will be maintained at a low heat; and this must have a bad effect on the heat of the end of the retorts. On the other hand, with a 2-inch layer of non-conducting bricks on the outside of the wall, it is obvious that the heat will penetrate to within 2 inches of the outside. In our case, the 2-inch thickness of bricks merely covers the iron flanges of the mouthpieces and mouthpiece sockets; so that the whole of the length of the retort is covered by highly-heated brickwork. As a matter of experience, I have found that, should a small hole be made in this outer layer of material, the fire-brick within is seen to be heated to a very high temperature—a yellow-red colour. A 2-inch course of non-conducting bricks has been laid on the top of the settings; and this, too, saves a good deal of heat from escaping. It not only saves fuel, but is also of benefit to men working on the beds.

We have further laid a course of tiles over the whole setting, 6 inches above the retorts. This should prevent much dissipation of heat through the setting arches, as there is a large air space between the top of the tile course and the arch of the setting. It should further save the lower ring of the arches from sinking.

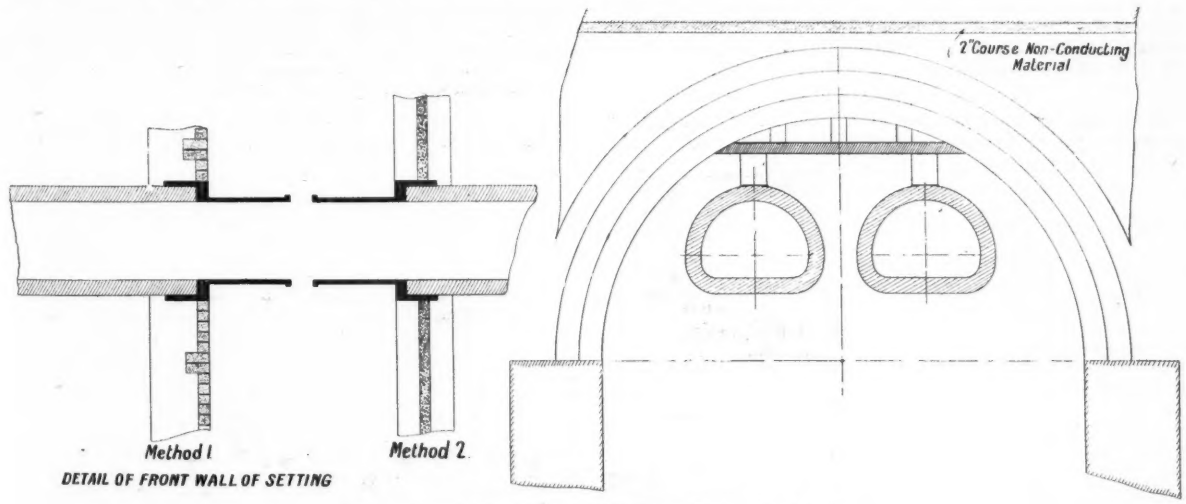


Fig. 8.—Prevention of Heat Radiation and Protection of Arch.

Discussion.

The President (Mr. B. R. Green, of Mitcham) said they would all agree that the paper was most instructive. The modern retort-house equipped with machinery had reduced the labour of the stoker to a considerable extent, and it had undoubtedly been the means of importing a different class of work into this portion of their business. It had tended to obviate the heavy labour which used to be considered so exceedingly trying. At the same time, there was still this question of dealing with the charging of the producers; and it had often occurred to him when going into a machinery equipped retort-house what a terrible job the charging of the producers was. At his own works at Mitcham, practically the only heavy work that had to be done was of this character; and when he saw Mr. Gill's idea for dealing with it, it struck him as being an exceedingly ingenious arrangement, which would be generally adopted in the future. He had already commenced to make some inquiries about it himself, and hoped to reduce the heavy work in his retort-house by the introduction of the machine.

The other "tips" the author had put forward would doubtless be of interest to all the members, while some of them at any rate would benefit very much thereby.

Mr. THOMAS GLOVER (Norwich) said he greatly appreciated this class of paper. It was a very useful one, and quite the right sort for the Association. He would like to ask if there was any rocking motion of the furnace-poker, or whether it was purely a piston working in a straight line. If the latter, it appeared to be not so good as a bar operated by hand. When men used a poker, they instinctively gave it an upward turn at the end of the stroke, and this helped to spread the fuel equally throughout the length of the furnace. If it was purely a piston pushing the coke into the furnace, unless the furnace was a short one he could imagine them getting a very compact charge at the front of the furnace, and a somewhat shallower layer of fuel at the back. It was true that the labour of charging furnaces needed with modern machinery was the heaviest work in the retort-house; but, in his own opinion, in a moderate-sized works it was not advisable to try to reduce the labour below a certain point. They might not have enough men to fall back upon for the machinery, if they had emptied their retort-house, and one or two men happened to be away. It was always well to have a few good men left, who could man the machines when necessary; and this was about the point that some of them had reached. They had reduced the number of men in the retort-house to such an extent that they would not care to reduce it any more. And manual labour, after all, was sometimes better and more intelligent than that which could be done by a machine. With the exception of this criticism, he had nothing but admiration for the poker. With regard to the non-conducting material in the front of the settings, it seemed to him that if they had a hard material they would have a compact material; and if they had a compact material they would have a conducting material. Mr. Gill said that at first they had soft material, and had suffered inconvenience, and so came to use a hard material. It seemed to him (Mr. Glover) that this was not very different from putting a thicker wall in front of the settings. The ideal material, he thought, had not yet been found for preventing radiation from the front of the settings, which they wanted to stop. His point was that if they had a hard material, they had a conducting material. With regard to the working of hydraulic mains and tar-towers, he had found that, by having heavy charges and filling the retorts up, the tar was so thin and the free carbon was so much reduced, that there was really no trouble in keeping the tar-ways open. With twelve-hour charges, there was no trouble whatever in working the hydraulic, tar-towers, and so forth, as compared with six-hour working. Then as to the shape of the stopper. He took it that the shape of the end of the charge depended upon the quality of coal used. If the coal was very small, it would form an almost vertical end. With washed nuts, however, he found an upright stopper quite all right, because when it was withdrawn the coal fell to its natural angle, and formed the tail-piece which was desirable for perfect carbonization at the end of the retort.

Mr. W. B. FARQUHAR (Ilford) remarked that there was only one point he was not quite clear about, and that was with regard to fig. 1. He was not sure whether this was drawn to scale; but it appeared to him that the handle for operating the machine was very close to the hopper. He took it that this machine was to keep men away from the heat as far as possible; and he would like the author to say whether it was actually in operation, and whether the handle as shown was in an ideal position. It appeared to him that the man would be quite close to the hopper, and getting the full benefit of the heat when the charging was in operation. Possibly the handle could be placed further back. It might, however, be put so near as it was in order that the man could see how the charging was being carried out.

Mr. A. F. BROWNE (Vauxhall) remarked that he would like to add a word to what Mr. Glover had said as to the undesirability of having a dense brick as a facing to the retort-setting, with a view to reducing radiation. There was in the market a brick of the description which Mr. Glover had specified as being desirable. It was very light and very cellular, with much air-space within; and it had been used at the works of the South Metropolitan Gas Company, or some of them, with very good effect. He thought it worth while to mention this, because Mr. Glover had said that such a brick was a *desideratum* which had still to be found. It was not customary at their meetings to mention by name the goods of any particular firm; but he would be happy to tell anyone interested the name of the brick, and where it could be procured.

Mr. GILL, on rising to reply to the discussion, thanked the President very much for his kind remarks. Mr. Glover, he said, referred to several points. For one thing, he asked whether there was any rocking motion in connection with the furnace-poker. There was none at all. They had this matter in mind when they designed the machine; and, as a matter of fact, they were nearly introducing a rocking motion. But they decided not to, and on trying the machine it appeared to throw the coke over to the back quite satisfactorily; and he had himself been well satisfied with it. The coke took up something like the same angle as it would if the furnace were filled by hand, with a man forcing it to the back. It threw the coke in with much greater force than a man could do. With a machine of this kind, it was no more expensive to put the coke into the furnace than to let it go down to the coke-hole. They could fill their furnaces as often as they liked—every two hours, say—so as to keep a sufficient layer of fuel in the furnace. As a matter of fact, at Wapping they filled every four hours; but it depended upon the depth of the furnace as to how often it should be filled. Mr. Glover also mentioned that in small works it was not advisable to limit the number of men. This was, of course, true. There was a limit to the size of works in which a machine of this kind should be fitted. Then he raised the point of the non-conducting material—that a compact material would not be so good as one of a more open nature. Of course, it certainly set a good deal harder; but it was of a much more open nature than ordinary fire-brick. The point was mentioned in his paper that, if one cut away a piece of this non-conducting material, one found the brickwork underneath very hot indeed; and if, instead of using a comparatively narrow front wall of non-conducting brick, they employed a wide wall, he did not think it would be so good, because the part must be cooler where it was covered by brickwork. Mr. Glover also said he had no trouble at all with hydraulic mains and keeping the tar-ways open. He quite agreed that with twelve-hour charges, the tar being so much thinner than with shorter charges, there was not nearly so much tendency to have any trouble with thick tar in the hydraulic mains. But he would point out that a large number of works were not able, for various reasons, to work twelve-hour charges; so that in these cases the difficulty of thick tar in the hydraulics was still a very real one. At Wapping, all their coal was carbonized in twelve-hour charges, and they had no trouble with the hydraulic mains; but in their case, he attributed this largely to the working of the arrangement described in his paper. With regard to the coal-stopper. The coal at his works was nearly always very fine; and he thought that, in being driven through the retort, it got slightly sticky, and so came up against the stopper and stayed in a practically vertical mass. With nuts of the description Mr. Glover had referred to, a perfectly upright stopper would no doubt be quite satisfactory. Mr. Farquhar asked about the handle of the machine in fig. 1. This machine was under construction now, and very likely the detail he mentioned could be improved upon. No doubt the further they got the handle away from the furnace the better it would be. He had been much interested to hear Mr. Browne's remarks. It might be they were both using the same class of brick. This he did not know. Mr. Browne, however, appeared to be very satisfied with the type of brick he was using; and he (the speaker) was equally satisfied with the one they were using at Wapping. It had fulfilled all his expectations.

UTILIZING PEAT IN GAS-PRODUCERS.

On account of the lack of suitable coal deposits in the central provinces of Canada, and the rapidly decreasing supply of wood, the Canadian Government have taken an active interest in the exploitation of peat bogs, with the view of developing from the deposits a fuel supply independent of outside sources. Not only has the use of peat as fuel been considered, but the question of its utilization for producer gas has also received attention. A producer has been installed at the Fuel-Testing Station, Ottawa, and exhaustive investigations have been conducted to determine the suitability of peat for this purpose. It is stated that gratifying results have been obtained. Mr. B. F. Haanel, the Chief Engineer of the Division of Fuels and Fuel Testing of the Department of Mines, Canada, who discussed these results in a paper presented at the Eighth International Congress of Applied Chemistry, explained that the process used in mechanically manufacturing peat fuel treats the raw peat and utilizes the sun's heat for drying. The following outline of the process, prefaced by the above introductory remarks, has appeared in "Engineering Record."

The raw peat is fed into a pulping-mill consisting of a series of revolving knives rotating against fixed knives. By this treatment a homogeneous mass is secured, and by breaking the cell walls the contained moisture evaporates more easily. After thorough pulping, the peat is taken to the drying-field, spread out, cut into blocks of suitable size and thoroughly dried. The moisture content is reduced by this process to 25 or 30 per cent., below which it is not considered economical to proceed.

On account of the hand labour involved, the estimated cost of a ton of peat fuel is about $2, including interest on capital invested and a profit of 15 c. per ton. To put the industry on a paying basis, it is recommended that the excavation and spreading should be performed automatically and on a large scale. A plant is now being installed to meet these requirements. On account of the low heating value of peat fuel, it is not considered suitable for steam raising, though well adapted for making producer gas.

The high percentage of nitrogen in Canadian peat thus far examined peculiarly adapts it for plants designed for obtaining ammonia. The nitrogen in the peat is recovered as ammonium sulphate, for which there is a large demand in the fertilizer industry. However, the common type of producer employed for peat is not constructed for the recovery of bye-products, but rather to burn the fuel with the highest possible thermal efficiency. The Körting producer erected at the Ottawa Fuel-Testing Station is of this type, and is designed not only to obtain the complete gasification of all the combustible components in the peat, but to destroy rather than recover any of the bye-products. It was found necessary to modify the type of producer in some details before economic results were obtained; but the investigation, in the opinion of Mr. Haanel, has proved that the peats tested are an economic source of power.

PIPE JOINTING, AND A FEW NOTES ON MAIN LAYING.

By W. George Head.

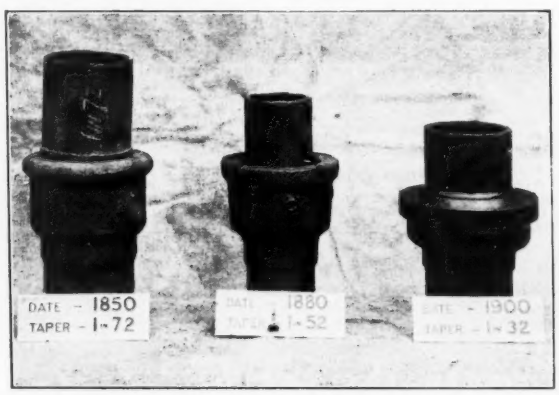
South Metropolitan Gas Company, Old Kent Road, S.E.

[A Paper presented to the Southern District Association of Gas Engineers and Managers, Nov. 14.]

In putting these few notes together, I feel that there is very little I shall be able to say that will not be common knowledge to you all; and for this reason I must ask your indulgence if this proves to be the case. I propose, first, to state some experiences with turned-and-bored cast-iron mains; secondly, to deal with laying and jointing steel mains for high-pressure work; and, finally, to mention a few items which may be of interest in connection with main-laying generally.

Turned-and-Bored Cast-Iron Mains.

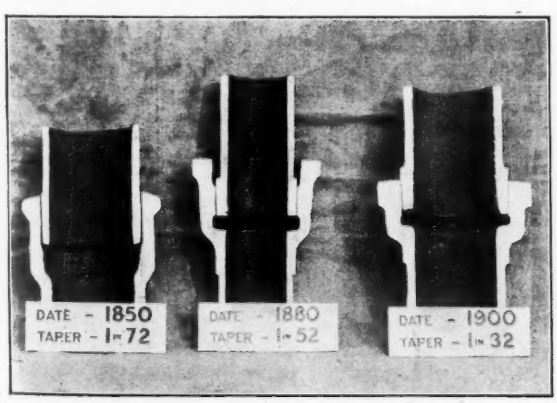
The South Metropolitan Gas Company have from very early days laid turned and bored cast-iron mains, and are at present doing so. They are continually unearthing turned and bored joints which have been in the ground considerably over fifty years, and generally, as far as appearances go, they are still good for an indefinite period. The joints of these very old turned-and-bored mains are certainly in better condition than the old lead-joint pipes, as the pressures then were very low, and, consequently, the amount of lead in the joints was sometimes very small.



1. 2. 3.

Fig. 1.—Types of Turned-and-Bored Joints. No. 3. S.M.G. Co's Standard.

The earliest turned-and-bored joints were made with "open" sockets—that is to say, there was no recess in the front of the socket which could be run with lead or cement if it was thought advisable. Later on, all turned-and-bored joints had recessed sockets; but as a rule the recessed portion was not run. [I am speaking, of course, only in connection with the earlier South Metropolitan Gas Company's practice.] The open socket type is the one now adopted. [See figs. 1 and 2.]



1. 2. 3.

Fig. 2.—Sections of Turned-and-Bored Joints. No. 3. S.M.G. Co's Standard.

Until about twelve years ago, all the makers had their own standard for turned-and-bored joints; and a great deal of inconvenience was caused by one maker's pipes not following another's. This is still experienced when relaying old pipes that are too good to be broken up. When Mr. Carpenter first became Chief Engineer, about twelve years ago, he readily saw these defects, and at the same time appreciated the advantages of the system, provided the joints were properly standardized, and the standard dimensions adhered to. At the invitation of Mr. William King (then Chief Engineer of the Liverpool United Gas Company), he visited Liverpool, and acquainted himself with the methods of testing and laying which had been in vogue there for many years. Gauges were made, and now, when an order is placed with the makers, a special standard joint is supplied to them, to which the pipes have to be made. [See fig. 3.]

Fig. 3.—Pipe Maker's Model. S.M.G. Co's Standard T. and B. Joint.

The inspector has his special gauge [fig. 4] to try the taper and size of the turned-and-bored part of the sockets and spigots; and, in turn, there is a special standard gauge [fig. 5], which never leaves the Company's works, with which to try the inspector's gauge. The inspector's gauge is ingeniously made so as to ensure

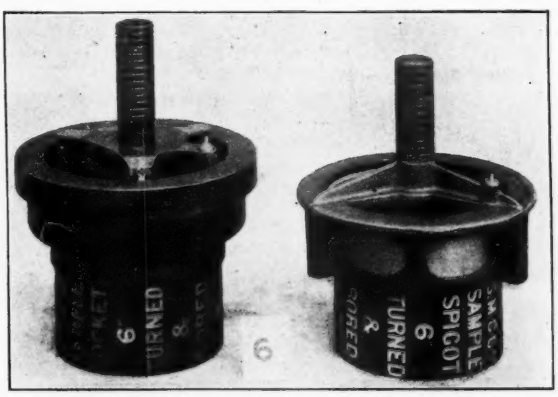


Fig. 4.—Inspector's Gauges on Model. S.M.G. Co's Standard T. & B. Joint.

the taper being absolutely accurate; but at the same time it allows a small amount of licence as to the length of the machined portion, also the maximum and minimum diameter of the top and bottom of the socket and spigot respectively.

You notice that the taper of the standard type of joint is

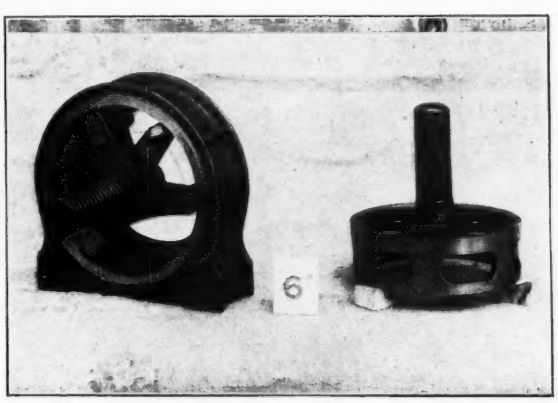


Fig. 5.—"Master" Gauges. Inspector's Socket Gauge being tried. S.M.G. Co.

much sharper than the earlier joints; the earliest joint having a taper of 1 in 72, and the present one 1 in 32. The recessed socket joint has a taper of 1 in 52. With the slight taper, one is apt to split the sockets on driving the spigot home; and after many experiments, the present taper, 1 in 32, was found most suitable.

When making the joint, both the socket and spigot are well cleaned, and then painted with thick red lead paint. Two or three strands of thin yarn are wrapped round the end of the spigot, which is then driven well home into the socket. The smaller pipes up to 9-inch diameter are driven home with a maul.

The larger ones are driven home by the next pipe to be laid, which is swung from the lifting legs against it like a boomerang; a dolly of hard wood being used as a packing-piece to drive against. The strands of yarn have the advantage of making the joints slightly flexible, and at the same time do not in any way have an ill-effect on the soundness of the joint. The earlier joints were not made with yarn, or worsted, as is sometimes used.

In the works, turned-and bored pipes are used for all the tar and liquor mains and connections, which, as you are aware, vary considerably in temperature. The joints stand admirably; and where there used to be many leaky joints—especially after a Sunday's "stopping off," when the pipes cooled down and drew the lead joints—these are now things of the past.

Advantages of Turned-and-Bored Pipes.

The total mileage of mains on the South Metropolitan Gas Company's district is about 1300; and of this it is estimated that over half is turned-and-bored work. The average unaccounted-for gas for the last five years is 2·67 per cent.; and the average for all the London Companies taken together over the same period is 5·43 per cent. Some of this, at any rate, may be credited to turned-and-bored joints.

The joint is sound, and does not rely so much on the joint maker, especially where the joint is awkward to get at. The joints are cheap. The extra cost per pipe for turning and boring is as follows. [I have also included the average prices a contractor would make for ordinary lead joints, which will serve as a useful comparison.]

Diameter of Pipe. Inches.		Extra Cost for Turning and Boring. s. d.		Contractor's Price for Lead Joints. s. d.
3	9 feet long	0 3	per pipe	1 3
4	12 feet ,,	0 6	,, ,,	1 6
5	,, ,,	0 7½	,, ,,	1 9
6	,, ,,	0 8	,, ,,	2 0
7	,, ,,	0 8¼	,, ,,	2 4
8	,, ,,	0 10	,, ,,	2 8
9	,, ,,	0 11½	,, ,,	3 0
10	,, ,,	1 0½	,, ,,	3 6
12	,, ,,	1 5	,, ,,	4 2
14	,, ,,	1 9	,, ,,	5 0
15	,, ,,	1 11	,, ,,	5 6
16	,, ,,	2 1½	,, ,,	6 3
18	,, ,,	2 5½	,, ,,	7 6
20	,, ,,	2 9½	,, ,,	9 0
24	,, ,,	3 6	,, ,,	10 6
30	,, ,,	4 0	,, ,,	21 0
36	,, ,,	5 0	,, ,,	23 6
48	,, ,,	8 0	,, ,, (plus 2s. for cement running)	35 0

The amount of labour required to make the joint is little more than that for just laying ordinary pipes together. There are no joint holes to excavate; this saving considerable labour and expense, especially where there are heavy reinstatement charges.

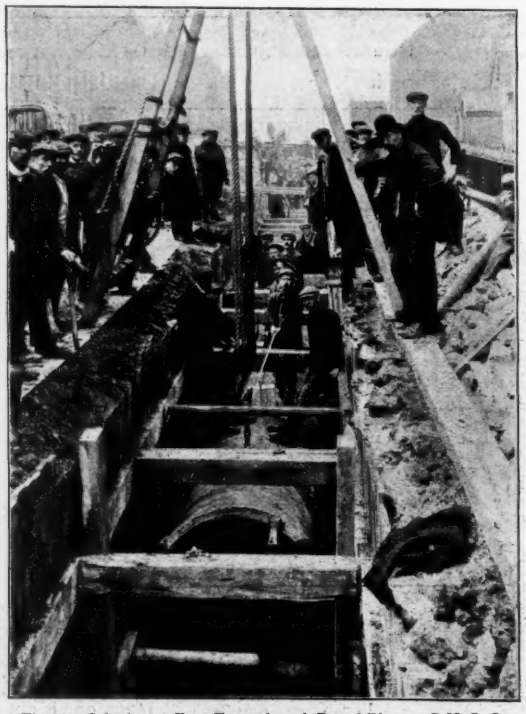


Fig. 6.—Jointing 4-Feet Turned-and-Bored Pipes. S.M.G. Co.

A gang used to laying turned-and-bored joints will, with a clear run, lay from 20 to 30 per cent. more pipes per day than with lead-joint pipes. A ganger and seven men can lay thirty 4-inch 12-feet pipes per day; and with double that number they can lay nearly 60. [See fig. 6.]

It is the practice to lay one joint in twenty with a lead joint, and about one in twelve with the larger pipes—special converting pipes being used for this purpose. All bends, tees, and other connections are made with lead joints. Turned-and-bored joints are especially suitable where the main is subjected to vibration caused by tramcars and other heavy traffic.

With very large pipes, such as 48-inch diameter, recessed turned-and-bored sockets are used, as there is sometimes difficulty in obtaining the machined portion perfectly accurate, owing to the springing of the casting when turning. It is usual then to run the recessed portion of the socket either with lead or cement, as an extra precaution.

Turned-and-bored pipes are easily shaken apart when a main has to be taken up. All turned-and-bored sockets and spigots should be well painted with white lead and tallow when being stocked, in order to preserve them from rusting. As in many other things, however, what first appear to be difficulties will, with experience, soon disappear.

Fig. 7.—Bored but not Turned Pipes!

Of ordinary socket-and-spigot pipes there is very little to say, except that about twenty years ago the Company laid several mains with the sockets run with Spence's metal. These in some cases have been satisfactory; but as a rule it has been found advisable to cut out the joints and re-run them with lead. A good deal of experience was required to make a Spence's metal joint. One can easily overheat and fire the metal.

The mode of making lead joints has practically not changed from the earliest days of pipe-laying. I will, therefore, pass on to steel mains, especially in connection with high-pressure gas supply.

Steel-Tube Mains.

The Company have in use about twenty miles of steel-tube mains, for high-pressure lighting, varying from 3-inch to 8-inch diameter. Being long and flexible, they are suitable for laying in crowded places where there are many other pipes, cables, &c., which makes it difficult to set-up the joints. [I have seen as many as fifteen pipes and cables in one narrow footway.]

The rigid form of joint has been used, and special attention has been paid to the method of making the joints, and the testing of the same. Several methods of making the joints have been tried; and the one which has proved most satisfactory is a combined run-lead and lead-wool joint. After the spigot has been well driven home, a strand of lead wool is well caulked into the bottom of the socket with a special tool made for the purpose. One or two strands of yarn are then driven tightly in to form a kind of cushion. Lead wool is then again caulked-in tightly up to about ½-inch of the face of the socket; this last portion being run with special soft lead, and then well caulked. Care must be taken to cool the joint with water immediately the joint is run, so as to avoid any expansion of the socket. [See fig. 8.]

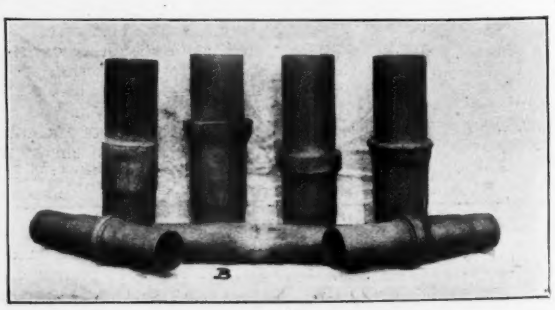


Fig. 8 —Types of Steel-Tube Rigid Joints. A and B are Welded Joints.

With run lead, it is only possible to caulk the face of the joint, the effect of the caulking only going back about ⅜-inch. Lead wool is, therefore, used, so as to be able to caulk tightly the whole of the joint, and, so as to avoid any risk of porosity, the face of the joint is run with molten lead. The lead wool or wire should be bright and unoxidized. It is better to buy new than run the risk of using up a stock which is old and dull. The joint should

be finished well back from the face of the socket. "Flush" joints should be avoided.

The form of tool used for caulking steel tube joints is of the utmost importance. Unsuitable sets will not only make a bad joint, but they will buckle the spigot of the best steel pipe. It has been stated that a sound joint can be made with yarn only. This has not been the South Metropolitan Gas Company's experience. After many trials and discussions, the special sets that are shown in fig. 9 have been devised and adopted; their object being to

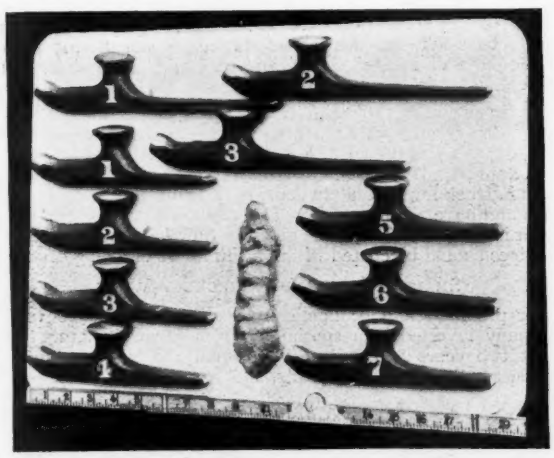


Fig. 9.—Tools for Making Steel-Tube Joints. S.M.G. Co.

give a straight horizontal blow parallel to the pipe when being used. The knob on the top of the set not only forms a handle for holding it but also for knocking the set back should it become fixed in the socket.

It is not only important to caulk the lead properly, but it is necessary to have the socket properly shaped to ensure a sound joint. This applies to all types of sockets whether they are of the rigid or loose type. As there are fewer joints in a steel main than with a cast-iron main, the strain on each individual joint is apt to be greater.

A socket should be so made that, in the event of any movement in the main, the joint will remain sound. It should, therefore, be slightly tapered inwards towards the face, so as, in the event of any drawing movement the lead will wedge itself tightly in the socket. This is a most important point. The greatest care should be exercised to ensure that the sockets are properly formed, and also have plenty of metal in them. A weak socket is to be avoided. The internal shape of a socket in a steel pipe, and to some extent in a cast-iron pipe also, is as important a factor as the true machining is in a turned-and-bored pipe.

Though the design of the socket may be correct, the actual shape may vary considerably according to the state of the mandril on which it is made. [This applies more especially to the forged type of socket.] All steel sockets are gauged for shape. There is a steel disc fitted with a handle, which is just large enough to pass into the socket. The disc should be a tight-fit at the face of the socket, and loose at about ¾-inch back. Only a very little taper is necessary; *but the taper must be there.*

Another important item with steel pipes. The pipes should be sufficiently thick so that the spigots do not buckle when the joint is made. A pipe which buckles in the socket is, to my mind, too thin to be serviceable. To put the above in a nutshell:

Have good thick tubes.
Have the right shape socket, and have it strong.
Have the right jointing material.
Have the right tool to caulk it with, and caulk well back.
Last, but not least, have a good and strong joint-maker.

All street mains are liable to have a steel wedge or a pick driven into them. To cope with this emergency some provision should be made. A temporary split collar may be used to clamp over the injured portion; but the pipe will be buckled in, and its area diminished. It will, therefore, be necessary to cut out and insert a new length. With a large steel main this means a lengthy and expensive operation; and it would be a good thing if the steel tube makers would supply a special fitting which could be efficiently used in such a case.

Some enthusiasts will say "our pipes will withstand a pick or a wedge, and that they will bounce off as the pipes are so thick." This is not so. There is the risk; and provision as mentioned above should be made accordingly. Both cast-iron and steel mains alike are liable to this form of accident.

Cast-iron "testing pieces" are sometimes useful when laying long lengths of steel main. This is made like a collar, but with a disc cast upon it in the middle. It may be temporarily inserted at various places, so as to test the main in convenient lengths. Two cast-iron caps placed back-to-back may be used for the same purpose; but the single casting has the advantage of holding the two spigot ends rigidly in place, so that when the casting is broken out the steel double collar, which should be a close fit, can be easily slid along. Care must be taken not to leave any pieces of the casting in the main. The steel collar is, of course, slipped over the end of the pipe before the testing-piece is jointed on. The castings are made as thin as possible, both for cheapness, and so as to be easily broken. It is advisable to paint the disc with red lead paint, so as to fill up the pores of the metal, or else it may not hold the pressure.

After the first installation of high-pressure lighting was completed, it was found that ordinary cast-iron syphons were unsuitable. The air at high-pressure (20 lbs. per square inch) used for testing, escaped through the pores of the iron. Special syphons were designed. Some were of cast-iron, some malleable, and some were even enamelled inside like a bath, in order to get them tight. They were all more or less satisfactory.

Steel syphons have since been made in the Old Kent Road smiths' shop with complete success, and some have also been constructed by the tube makers on the same lines as steel oxygen

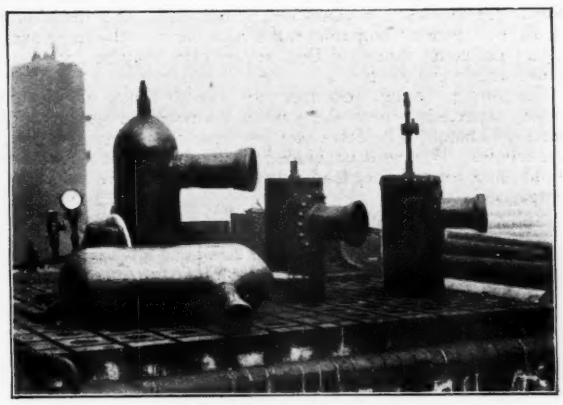


Fig. 10.—Steel High-Pressure Syphons.

bottles, which have proved equally successful. Fig. 10 shows both forms. The syphon stand pipes are fitted with valves, so as to avoid the risk of emptying the syphon, and allowing the gas to escape, should the cap be removed or become loose when the gas pressure is on. All syphons have been laid away from the line of main by inserting tees and fixing the syphon on the outlet. The syphon can be removed at any time without interfering with the main, and it is in other ways also convenient.

As in the case of cast-iron mains, all pipes are uncoated inside, and the outside of the spigots are also left uncoated. Experience has taught most people the folly of having gas-mains coated inside. Great care should be taken with wrapping the joints. It is difficult to do the wrapping as well in the trench as the makers do at their works, where the pipes are immersed in the hot solution. It is not an unwise plan to paint the joints with red lead paint

Fig. 11.—Portable Air Compressor (Large).

before wrapping. The welds on the tee and branch connections should be treated in this manner. It is sometimes advisable to put a red lead bandage on before the ordinary pitch compound bandage.

All tees and connections are tested with air pressure at 30 lbs. per square inch before they are laid, and all mains when laid are tested with air at 20 lbs. per square inch, and the joints tried with soap and water. The pressure is pumped up at night with a small motor pump; and it has to remain constant until the next morning. The joints are examined while the pressure is on; and they have to be certified before they are wrapped and the ground filled in. A barometrical mercury gauge is used, which shows the slightest variation in pressure. This type of gauge has been in use for this purpose for several years past. It is well to have the tubes cut in dead-lengths, as it would be difficult to find the joints at a future date should an escape unfortunately occur. The extra expense is very slight.

All the services have been fixed by means of wrought-iron split collars bolted on the main, the service-pipe being screwed right through both the clip and the pipe. This makes the strongest form of joint, and should withstand any strain which might be caused by the service being knocked or jarred, should the ground be opened for any purpose other than for gas supply. None of the patent ferrules on the market have been adopted. Steel plugs and caps have also proved satisfactory.

Much has been said by engineers for and against steel-tube mains, concerning their life; but provided the makers maintain the quality and substance of their tubes, and provided reasonable care is taken with their laying, they will, I believe and hope, using a horrible term, "more than last my time." Last year a large 24-inch steel-tube connection, which had been for fifteen years in the ground, was taken out at Woolwich. It was in as good condition as when put in. The red lead paint was still visible.

I have seen and tested steel pipes with the joints made by the oxy-acetylene process, and see no reason why these should not prove satisfactory, provided all conditions for laying are suitable. The joints are cheaply and quickly made; and they certainly look a business-like job.

Fig. 8 shows various forms and makes of rigid steel-tube joints, including the welded joint.

Lastly.

Except in the case where a main is laid "dead"—that is, without being connected to a live gas main—disc stoppers are ordinarily used. These have proved a most convenient piece of apparatus. It avoids cutting a lot of bag-holes, and also does away with blowing-off the air each time the bags are moved forward. The stopper is pulled forward after each pipe is laid and jointed. One can follow up closely with the filling in; thus saving the necessity of having very long trenches open, which is a great advantage in busy thoroughfares. As soon as each pipe is laid and jointed, it is charged with gas, which to my mind is advantageous. Stoppers are also very convenient when ceasing work at night time; the stopper is left in the main, and the end clayed-up as usual. To use a stopper whenever possible is, I think, quite a good rule.

When bagging mains, two bags should be always used, with a stand-pipe between them and carried well up into the air to take away any escaping gas. This is much more satisfactory than attempting to fill the space between the bags with water which, if the pipes are at all rough inside, is impossible. Larger bags should be tied to a stick or to some convenient object.

When bagging large mains, such as 48-inch, a relief bag is used so as to regulate the tightness of the bag, and also to avoid the risk of bursting it by pumping it too tightly. The relief bag is connected up between the 48-inch one and the pump, and it has a relief valve fitted in it, which blows at 1 lb. per square inch. When this blows continuously, the valve is closed and the pump shut off. The bag is then pressed by the foreman which gives the final puff to the 48-inch bag. In this way the tightness of the bags is nicely gauged. The most convenient way to use the relief bag is to sit astride it. It is the easiest way to adjust the pressure.

When cutting or breaking out a main, always have plenty of water handy, and throw a little on the pipe between the strokes of the hammer. In this way, the risk of striking fire will be reduced to a minimum.

As far as possible all mains are coated on the outside. Recently some 48-inch pipes were taken up which were laid between 25 and 30 years ago, and the coating was as bright as if it had only just been applied. If a pipe maker informs you that he has several pipes in stock for immediate delivery, it is waste of money to pay extra and have them coated. The pipes will already be rusty; and it is no good coating the pipes if they have started to rust. All pipes should be coated within a few hours of being cast.

Small Repair and Emergency Work.

For promptly and economically dealing with the above, the Company invested in a special motor caravan—fig. 12. Until about two years ago most of the small repair work—such as broken small mains, leaky joints, and stopped and water-logged

Fig. 12.—"The Caravan" at a Job. S. M. G. Co.

pipes—were dealt with by two gangs of about nine men each. The mains department is entirely worked from Old Kent Road, and with a large district, extending from Wandsworth Common

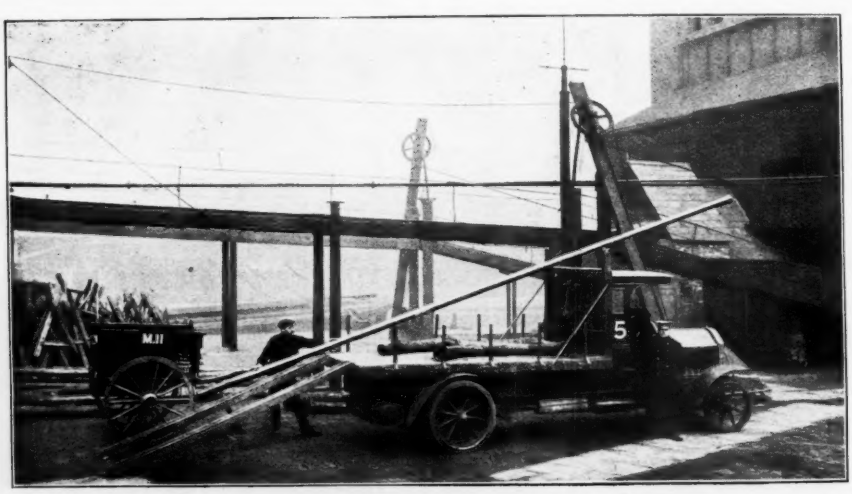


Fig. 13.—Pipe Lorry. S. M. G. Co.

nearly to Erith, a great deal of time was wasted in getting from one job to another—in fact, it was not unusual for it to take longer to reach the job in question than it took to do the job itself. It also often necessitated sending two, three, or more men away from big gangs which happened to be close at hand to attend to minor jobs; and this had a most demoralizing effect on the men. It upset the work of the gang, and was generally unsatisfactory.

The motor caravan carries a foreman and six or eight men, with all the necessary plant and material for dealing with any ordinary work. It is fitted with lockers for the men, ambulance appliances with oxygen apparatus, light bamboo poles, light but rigid folding trestles, lamps, and a gas-cooker which is fitted with a special burner in the grill plate for heating lead. This is connected-up to the nearest gas-lamp. The motor travels about 300 miles per week. The foreman will often drop two or three men on

one job, and then go on with the rest to a second job. He will then return to the first, and perhaps pick them up and take them on to a third job.

It is sufficient to state that now one foreman and six men can do all the work formerly done by two foremen and eighteen men, and the other gangs are practically never interfered with. The jobs are thus promptly dealt with, with the minimum of expense. A plumber is also connected with the gang, who repairs lead pipes when they are unfortunately broken.

The mains department also possesses another motor; and this is in the form of a large pipe lorry—see fig. 13. This, again, is almost worth its weight in gold. It averages the work of six horses and vans; and on some jobs it does the work of ten horses.

The lorry is so constructed that it will carry practically everything required by the main layers. Horses are only used for carting away rubbish to the shoot. It is fitted with a winch for loading heavy 24-inch and 30-inch pipes (it carries five 24-inch pipes), and also for loading up the main layers' truck, and all the poles and trestles. It will shift a large gang of 24 men, together with their truck, poles, and trestles and tools, in one journey; and it is quite a unique sight to see such a large gang, with all their palaver, moving off to their next job.

This lorry is exceedingly useful for transporting the 30-feet steel tubes. It takes thirty 6-inch tubes at one load, together with connections and other requirements. Another reason why the motor lorry is desirable, and which is by no means an unimportant one, is that it does away to a large extent with using hired horses. It is most undesirable for a prosperous and reputable company to have its haulage done by contractors, whose cattle are often jaded in appearance, and are sometimes more fit for "cat's meat" than for work.

Main-laying work in a large company in a district like that of the South Metropolitan Gas Company's is most interesting. There are numerous corporations and companies who have their pipes and cables under the ground, there are the tramways who take up nearly all the room, there are sewer entrances and manholes of various descriptions and sizes, which all come in one's way. But there is one thing which must be common to all, and that is good feeling between all concerned. Let the rival undertakings compete one against the other for the disposal of their wares, but do not let it make unfriendly feeling between those who have to do the transporting. It not only makes it unpleasant, but it will make it unnecessarily expensive.

While summarizing his paper, Mr. Head had the illustrations thrown on the screen by a lantern.

Discussion.

The President (Mr. B. R. Green, of Mitcham) said that the description Mr. Head had given them of the methods adopted by the South Metropolitan Company in connection with their mainlaying operations had been to him at all events quite fascinating. It had been his privilege to see, through the kindness of Mr. Carpenter, some of the work carried out; and he must say that he was greatly struck with the simplicity of the whole thing from beginning to end. The complete models of which the Company were in possession, from the smallest size up to the largest, were undoubtedly very necessary, if this turned-and-bored work was to be generally adopted. He (the President) had had a good deal of information furnished to him about the system; and he would undoubtedly say that the very low percentage of unaccounted-for gas in the South Metropolitan Company's area was largely due to the turned-and-bored mainlaying. He was extremely sorry to find that they appeared to have "bitten off more than they could chew" in getting so many papers for the present meeting. They had turned out so interesting that a longer time than usual was required for discussion. However, there were still a good number of members present, and he hoped that Mr. Head's paper would be discussed.

Mr. Charles Carpenter said that he desired to express his appreciation of the admirable paper which Mr. Head had submitted. When he first saw it, the feeling came over him that it was a pity it could not be given to a larger audience. But this feeling died the moment it was born; for he remembered the intelligence with which the Southern Association had always discussed practical papers of this kind. The question of mainlaying was most important. When he went to the Old Kent Road, twelve years ago, his knowledge of the turned-and-bored system was confined to its use for large water-mains, where it was the practice—and he supposed it was still—to turn the spigot end, in order to ensure that it was central and firm in the socket, and then to run the front of the joint in the usual way, so that the turning and boring was practically a substitute for the ordinary yarning operation. He went there very sturdy in his belief in the advantages of lead joints—of which he had seen a good number, and had made one or two—and he was much struck with Sir George Livesey's enthusiasm in the matter of turned-and-bored joints. Sir George said that what he had always noticed, when they were taken to pieces, was that, no matter how many years they had been laid in the ground, the red lead was as perfect in colour as when the main had been put down. But he (Mr. Carpenter) found, as Mr. Head had pointed out, there was a good deal of difficulty, owing to the diversity of the various makers in regard to their ideas as to the dimensions of sockets. Therefore the Company had standardized them; and in this matter they had had a great deal of help from their Works Superintendent, Mr. Gibson. As the result, turned-and-bored pipes, from the smallest to the largest size, were now laid with the greatest facility. They made exceedingly good work, and were satisfactory in every way. They had, as Mr. Head had stated, got over many of the difficulties that were encountered, he supposed, in all large works in regard to the pipes conveying tar and liquor long distances from the retort-houses. In all the Company's works, the whole of the tar and liquor connections, with the exception of a small amount of wrought-iron work, were laid on this system; and whereas it used to be quite a common thing—due partly to changes of temperature and partly to the action of ammoniacal liquor on lead—to have leaky joints, they had never seen one since adopting the turned-and-bored system. The result was that they sold a great deal more of the ammonia and of the products than was very frequently the case. Again, he congratulated Mr. Head on the admirable, painstaking paper he had written. If they could all throw themselves as enthusiastically into their work as Mr. Head did into mainlaying, it could not fail to do good to the industry with which they were all proud to be connected.

Mr. R. B. Parkinson (London) remarked that, though not a member of the Association, he had been asked to come to the meeting, having had an exceptionally varied experience in mainlaying in steel. He wanted first to congratulate the Association on having a paper on turned-and-bored joints. It was an evil day for the gas industry when this joint was practically abandoned, except by the South Metropolitan, the Liverpool, and one or two other companies. He passed every morning on his way to Westminster what was to him a terrible sight. He saw it from the top of the tram, and had not got off to look closely into it; but it was evidently an old cast-iron main, every joint of which was being opened. The cost of opening all these joints must be appalling, because the concrete and the wood paving over it had to be replaced. And as there was a service of motor omnibuses just starting down the road, he supposed they would all be leaking again soon. He had counted 91 of the joints so far, and probably the number would go well over 100 before they were all set-up. The long-sleeve joint for which he was responsible, which was used with steel tubes, was practically the same in principle as the turned-and-bored joint. There was only one thing he would like to mention. Several people had been caught over it in using steel tubes, which had been coated more frequently than cast-iron pipes. Unless the coating was scraped off the spigot, when it went into the socket it would be attacked by the gas. Even if the tubes were tested by high pressure, the gas would eat away the coating. So it was always as well, before completing the joint, to scrape away the coating. There was one other point. He wished Mr. Head, instead of the statement, "Except in the case where a main is laid dead," had said, "Except in the case where a main is laid alive." He (Mr. Parkinson) thought mains should always be laid dead where it could possibly be arranged. He knew it was difficult to do in towns sometimes; but they should wherever practicable be laid dead, so as to have a good high-pressure test. If they had this, they could go away and leave the test, and it would find out all the weak points.

Mr. T. May (Richmond) said the paper gave rise to the reflection, "Why have we stuck to lead joints for so long?" He himself laid turned-and-bored joints thirty years ago, mile upon mile; and they were very easy to lay. One got twice as much work in a day, too, with a gang of men. Yet, like other people, he had gone on making lead joints. It was most extraordinary. They got into a groove, and stuck there; and one of the most useful things that the paper would probably effect would be to cause them to ask themselves once again why they did not use turned-and-bored pipes.

Mr. R. Beynon (Torquay) inquired whether it was not necessary to have a larger amount of specials in order to get round bends, than would be the case with open joints. It occurred to him it might be possible that, where they had a number of sharp curves which would not in the ordinary way necessitate special castings with open joints, it might be necessary to use specials with turned-and-bored joints.

Mr. D. Irving (Bristol) said that some thirty years ago he had considerable experience in the laying of turned-and-bored pipes for both gas and water; and the system used was most satisfactory in its results. The class of joint they used had the open part of the socket not filled up with lead, but with portland cement. Cement was used regularly for both gas and water. He never knew of any difficulty in the laying, or in the working after it was laid, of the turned-and-bored pipe, excepting when he came south. He then came in contact with turned-and-bored joints similar in pattern to some of those shown by the author; and in all cases where there was any subsidence, there was a tendency for the spigot to draw. There was always great difficulty in making the joint tight in such cases. While now he, like the previous speaker, seemed to have gone back to the use of lead, still he had a very great liking, from his early experience, for the turned-and-bored joint. He rose, however, principally to tender his thanks and congratulations to Mr. Head for the very interesting account he had brought before them of mainlaying generally, and especially to congratulate him and his Company on the excellent organization of their Mains Department.

Mr. W. B. Randall (Waltham Cross) asked whether the author had had any experience in clay soil, where, particularly in dry summers, they got considerable expansion and contraction of the

soil. Was any expansion joint used? It occurred to him that if there was any contraction, one was bound to get a leak from a turned joint.

Mr. HEAD, in replying to the discussion, thanked the members for the kind remarks they had made. He said he was sure the President was interested in turned-and-bored work, from the fact that he believed he was himself going to adopt the system to some extent. He also thanked Mr. Carpenter for what he had said with regard to his enthusiasm in mainlaying. It was really most fascinating work. He could liken it only to one thing, and that was standing on the stage of a retort-house, and watching the coke come out of a new setting nicely burnt off. Mainlaying in difficult places, and getting round tight corners, was like this. One speaker had said that steel-tube joints of the rigid type were practically turned and bored. To some extent they were; but with all steel-tube connections they varied considerably. In one joint they might make, the spigot would take a considerable amount of driving in; and in the next one it might be to some extent loose. There was a certain amount of variation in the joints, and also in the material used; so that he could hardly agree that the rigid type of joint was the same as a turned-and-bored joint. All mains should be laid dead as far as possible—they should be laid in long lengths, and tested with air when completed. But in some cases this was not permissible. In busy thoroughfares it was absolutely necessary to have the trenches as short as possible, and to follow on closely with the work. There was, however, one point Mr. Carpenter mentioned to him once, and which they had always followed out since; and that was never to fill a joint in until it had had the maximum pressure on it. They could generally arrange this. At dinner-time they could have the maximum pressure; and if the joint was tight then, it would be all right. This was the best safeguard they could have. Lead joints were always used for specials in district work, because with big pipes there would be some difficulty in driving (say) a quarter bend at right angles to the last joint. They might break the joint. On the works, however, he believed that turned-and-bored joints had been used for such work. But there the pipes were small, and there was not so much jar as there was with 24 or 48 inch pipes. Portland cement had sometimes been used for filling in the front portion of the joints, and sometimes they had caulked and run them with lead in the usual manner; but they had many hundreds of 48-inch turned-and-bored joints which had not been treated in either way. They had laid thousands of turned-and-bored pipes in clay soil; but they were laid sufficiently deep for the cracking of the clay not to get down to them. At the depth at which the mains were laid, there was practically no variation in temperature. They did, however, put in a lead joint—say, one in twenty, or with larger pipes one in twelve. But whether or not it was absolutely necessary he could not say, because the lead joints being this distance apart, if there was going to be any movement in all probability it would not reach so far as the lead joint. He thought they might say the variation of temperature of the ground 2 ft. 6 in. or 2 feet deep was so small that it was practically negligible; and most escapes, especially of to-day, were due to vibration. One speaker said he had seen a lot of holes. It had been necessary to set-up some of the lead joints. This was due, he believed, to the tramcars, because when one stood on a pipe and a tramcar went past, however deep the pipe was one could feel it. A weight of 25 tons running, supposedly at fifteen miles an hour but often faster, went thump, thump, always on the same place. It was not like a motor omnibus or other traffic; and tramcars were, to his mind, the cause of more damage than anything else. It was in such cases that turned-and-bored pipes had proved admirable. They had them in the most crowded districts where there were tramcars; and they had never had to go to them for leakage because of vibration. He thought this was saying a great deal. He again expressed his appreciation for the reception accorded to him.

Scientific Shop Management on the Taylor System.

This was the subject of a paper read by Mr. C. C. Allingham at a recent meeting of the Junior Institution of Engineers. The principle adopted by Mr. Taylor and his associates has been to analyze every piece of work into its component elements, and study each element separately; and the author said a comparatively simple law could be arrived at governing the time required for each element, whereas if an attempt were made to study the job as a whole the number of variables would be so great that no definite result would be attained. When once the times required for the elements had been ascertained, the total time needed to do any piece of work might be calculated. The elementary times were ascertained by means of time-studies—*i.e.*, by timing with a stop-watch a first-class man when doing the work. While this was in progress, a trained observer was carefully watching the motions of the man; and intelligent and close observation of this kind had resulted in many considerable improvements being made in the methods of carrying out manual work of all kinds, as well as the speeding-up of machines by the modification of details. In order to induce the men to do their best, they were paid a large bonus if they completed their work within the time allowed. In some cases, their earnings were increased by from 30 to 100 per cent. above the current rates; but the amount of work performed per man was three or four times greater than before, so that the labour costs were less. The system is already in extensive use in America.

HIGH-PRESSURE GAS.

Lecture by Professor Burstall.

Professor F. W. Burstall, M.A., delivered the first of a series of four lectures on "High-Pressure Gas" before the Midland Junior Gas Association, at the University of Birmingham on Thursday last.

He said: In delivering these lectures on "High-Pressure Gas," it is not my intention to go into the problem of the applications to various purposes, but to study the purely scientific aspect of the subject as regards the laws which govern the compression and transmission. Once these have been mastered, it is a very simple matter to follow the applications, but is one in which those directly engaged in the gas industry can form a better judgment than any person whose interests are mainly from the scientific side. I shall assume that those who are here present have some knowledge of mathematics, physics, and chemistry, as it is only by knowledge of these sciences that we are able to secure a firm foundation in any theoretical treatment.

Before it was proposed to use gas under pressure, compressed air had been very widely employed for a variety of purposes, but principally in connection with mining; and hence the special theory has been fully developed. The only change required when we have to consider gas is that the constants are not the same. In all other respects the problem is precisely similar.

THE GENERAL PROPERTIES OF GASES.

Before proceeding to the special problems connected with the compression and transmission of high-pressure gas, it is necessary to start with the fundamental properties of gases—such as hydrogen, nitrogen, methane, carbon monoxide, carbon dioxide, and the higher hydrocarbons.

It is convenient for the moment to work in metric units, as these are so much simpler for the preliminary calculations. When the final results are obtained, it is an easy matter to change to the English system.

The first problem is to obtain the weight of a given volume of each of these gases. Hydrogen being taken as unity, the weight of all the other gases is an even multiple of that of hydrogen; the multiple being obtained from a knowledge of the molecular weight of a particular gas—*e.g.*, the molecular weight of hydrogen being taken as 2, that of oxygen is 16 times as much (that is 32). As the weight of one cubic metre of hydrogen is 0·0895 kilo. at a temperature of 0° C. and 760 mm. of mercury, the weight of a cubic metre of oxygen is readily obtained.

There are two laws which govern the expansion of gases. The first is known as Boyle's law, which states that if the temperature of a gas be kept constant the product of the volume and pressure is also constant. This is expressed mathematically by the term

$$P \times V = \text{Constant.}$$

The second law, known as Charles' law, states that under constant pressure for equal changes of temperature, there are equal changes of volume, and that all gases expand alike. This states that if V_0 be the volume of a given weight of gas at 0° C. and a the increment of volume per degree, then the volume of the gas at a temperature t° C. will be given by $V_0 + a\,t$.

On the Centigrade scale, a has the following values for different gases:

Air $\frac{1}{272{\cdot}8}$, Hydrogen $\frac{1}{272{\cdot}7}$, Nitrogen $\frac{1}{272{\cdot}6}$.

The general value taken for a is $\frac{1}{273}$ or, on the Fahrenheit scale, $\frac{1}{493}$ of the volume at 32° Fahr.

If Charles' law were to be taken as strictly correct below 0° C. as well as above, it would lead to a new definition of the zero on which temperatures are measured.

As the volume at a temperature, t, below zero will be given by

$$V = V_0\,(1 - a\,t)$$

and if t be chosen so that

$$1 - a\,t = 0,$$

the volume of the gas at this temperature will have vanished. The value of t will be -273° C. This is called the absolute zero of temperature; and temperatures measured from this point are called absolute temperatures, and are generally denoted by the letter T. All known gases, with the exception of helium, become solid before the absolute zero is reached, so that the law fails. Still, many indirect methods give the same value for the absolute zero; and as it leads to very important simplifications in thermodynamics, the absolute zero is a very useful conception. To express any temperature as measured from the absolute zero in terms of temperatures measured from 0° C., it is only necessary to add on 273—that is,

$$T = t + 273$$

or, what is the same thing,

$$T = t + \frac{1}{a}$$

Charles' law may now be expressed in the form—

$$V = V_0 \times \frac{T}{T_0}$$

If we combine the two laws of Boyle and Charles, we obtain the fundamental equation for gases—namely,

$$PV = RT$$

R being a constant depending upon the molecular weight of the gas. When the units are P in pounds per square foot, V in cubic feet, and T in degrees Fahrenheit, the values are:

Air	53·3
Oxygen	48·2
Nitrogen	54·9
Carbon dioxide	35·0
Marsh gas	96·3
Hydrogen	770·4

R being in foot-pounds.

In order to find the value of the constant R for any given sample of coal gas, it is necessary first to have the analysis by volume, which is then reduced to the analysis by weight, and the values of the particular constants put in.

The following is the mean value of an analysis by volume of a Birmingham coal gas:

Carbon dioxide	1·60
Heavy hydrocarbons	4·48
Oxygen	0·13
Carbon monoxide	9·46
Marsh gas	33·67
Hydrogen	43·40
Nitrogen	8·70

From this we must now work out the analysis by weight, which is found by taking into account the weight of a cubic foot of each constituent. When this is worked out, it is found for the sample in question that the weight of one cubic metre dry at 0°C. is equal to 0·633 kilo. The weight of a cubic metre of air is 1·290.

$$PV = 53{\cdot}3 \times \frac{1{\cdot}290}{{\cdot}633} T.$$

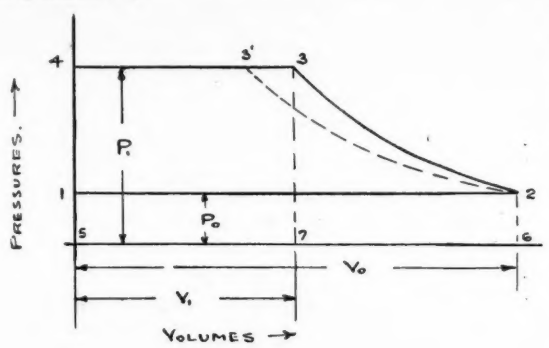
Which is equal to 109 T.

Now you will find that this value varies from 109 to 115 for ordinary coal gas. The best all-round figure to take is 110.

$$R = 110$$

From a scientific point of view, the problem of a high-pressure gas service reduces itself to two points: First, the problem of the compressing of the gas; second, its transmission through pipes.

Let us consider the amount of work done in compressing the gas. The diagram represents changes in pressure and volume, as 1 lb. of gas is sucked into the cylinder of the compressor at atmospheric pressure, P_0 lbs. per square foot, compressed during the return stroke of the piston till the pressure P_1 is reached, when the outlet valve opens, and the gas is forced into the receiver at constant pressure (P_1).



The diagram is composed of straight lines, with the exception of the part 2 3. The slope of this line depends upon how much heat is taken from the gas by the cylinder walls during compression. If more heat is lost, V_1 will diminish and the line 2 3 will fall lower (say to the point 3^1); thus diminishing the area of the diagram by the amount $2\ 3\ 3^1$. As the enclosed area 1 2 3 4 represents the work done in driving the compression, it will be of advantage to keep down the temperature of the gas as far as possible by water-jacketing the cylinder.

The heat developed during compression will be lost in the receiver or pipes long before the gas can be used; so it is best to carry this heat away during compression in the cooling water, thus lessening the power required to drive the compressor.

If the jacketing were so complete that the temperature did not rise during compression, we have seen that the product PV will remain constant. If, on the other hand, no heat were lost by the gas, the curve of compression would be represented by the equation PV^v = Constant, where V has the value 1·41 for air. For coal gas the value is very nearly the same. As neither of these cases can be obtained in practice, the actual curve of compression will be represented by the equation PV^u = Constant, where u has a value between 1 and 1·41. In practice, it is found that, with water-cooled cylinders, u will range from 1·3 to 1·2.

The value I shall select for calculations is 1·25. Further, I shall assume that the suction temperature of the gas is 60° Fahr.

Since $PV = RT$

$$P_0V_0 = 110\ (461 + 60)$$
$$= 57{,}500, \text{ taking round numbers.}$$

To find the work done in compressing 1 lb. of gas: The enclosed area 1 2 3 4 can be made up of the sum of the areas 4 3 7 5 and 3 2 6 7, less the area 1 2 6 5—*i.e.*,

$$P_1V_1 + P_0V_0^u \int_{v_1}^{v_0} \frac{du}{V^u} - P_0V_0$$
$$= P_1V_1 - P_0V_0 + \frac{P_1V_1 - P_0V_0}{u - 1}$$
$$= \frac{u}{u - 1}(P_1V_1 - P_0V_0)$$

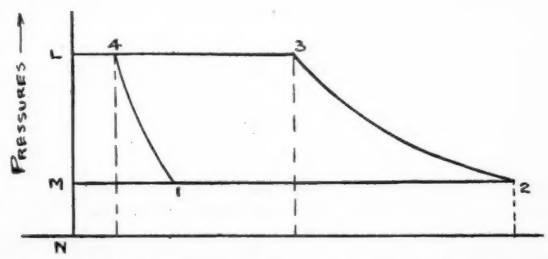
We wish to express the work done in terms of the final pressure P_1. Now since

$$P_1V_1^u = P_0V_0^u$$

we find $P_1V_1 = P_0V_0 \times \left(\frac{P_1}{P_0}\right)^{\frac{u-1}{u}}$

$$\text{Area} = \frac{u}{u - 1}\left[\left(\frac{P_1}{P_0}\right)^{\frac{u-1}{u}} - 1\right]P_0V_0$$
$$= 5\left[\left(\frac{P_1}{P_0}\right)^{\cdot} - 1\right]57500$$

which is the work in foot lbs. required to compress P_0 to pressure P_1.



We have hitherto supposed the whole of the air in the cylinder to be delivered into the receiver. In practice, when the piston has reached the end of its stroke, a certain volume of gas remains in the cylinder owing to the necessity of having a clearance. This clearance volume (V_c) is represented in fig. 2 by the line L 4. On the outstroke of the piston this clearance volume of gas expands, as shown by the curve 4 1; thus reducing the volume of the charge at pressure P_0 to that represented by the length 1 2. A certain amount of work is lost in compressing and heating this volume of gas at every stroke; but without entering in detail into the actual quantity of work lost, we shall assume in the following example that the loss due to clearance is 15 per cent.

Example: What H.P. is required to compress 600 cubic feet of free gas per minute from a pressure of 14·7 lbs. to a pressure of 21 lbs. per square inch absolute? The mechanical efficiency of the plant equals 85 per cent., and we shall allow a further 15 per cent. loss due to clearance.

$$5 \times P_0V_0 \left[\left(\frac{P_1}{P_0}\right)^{\cdot 2} - 1\right] \text{ foot lbs. per minute}$$

$5 \times 14{\cdot}7 \times 144 \times 600$ (·0755) „ „

$= 479{,}000$ „ „

$= 14{\cdot}5$ H.P.

Putting in the allowance for clearance and mechanical losses, the H.P. required to drive the compressor will be $\frac{14{\cdot}5}{0{\cdot}7}$ or 20·7 H.P.

Scottish Junior Gas Association (Western District).—We learn from the Secretary (Mr. David Fulton, of Helensburgh) that, in accordance with the programme of arrangements given in the "JOURNAL" last week, the members will visit the Auchenzeich Coke-Ovens, near Chryston (Glasgow), next Saturday. The works are in the hands of Messrs. J. Nimmo and Co., Limited; and the plant is on the Otto-Hilgenstock system. Sulphate of ammonia is manufactured by the Otto direct recovery process, which is operated in only one other place in Scotland. The visit should be specially interesting.

Power from Waste Gases.—In the course of his address to the Newcastle Section of the Institution of Electrical Engineers, Mr. W. C. Mountain, the President, gave some interesting figures relating to the power which can be obtained from the surplus or waste gases from blast-furnaces and coke-ovens. He pointed out that large gas-engines are now at work giving every satisfaction; and his figures for the power developed were based upon the assumed use of gas-engines. At about full load, a gas-engine requires about 10,000 B.Th.U. per B.H.P.-hour, or (say) 100 cubic feet of blast-furnace gas, or 22½ cubic feet of average coke-oven gas. From the gas-engine exhaust, from 2 to 2½ lbs. of steam at about 60 lbs. pressure can be generated per B.H.P. per hour; this steam being used for a variety of purposes. A modern coke-oven evolves about 10,000 cubic feet of gas per ton of coal coked, of which about half is surplus in the case of regenerative ovens. On this basis, and allowing for some losses, gas-engines using the surplus gas would generate eight or nine B.H.P. per ton of coal coked in 24 hours. Nothing like full use has as yet been made of the surplus gases from blast-furnaces and coke-ovens, though something has been done.

SOME NOTES ON OXIDE PURIFICATION.

By Mr. C. V. Townsend, of Wakefield.

[A Paper read before the Yorkshire Junior Gas Association.]

Much has been written on the subject of purification by means of oxide of iron; and while the author does not claim to have any new suggestions to make, he thought, as the matter has not for some years been discussed by this Association, that a short paper on a question which vitally affects most, if not all, of us would not be out of place.

We know the principal chemical reactions concerned with oxide purification—viz: Fouling, $Fe_2O_3H_2O + 3H_2S = Fe_2S_3 + 4H_2O$; Revivifying, $2Fe_2S_3 + 3O_2 = 2Fe_2O_3 + 3S_2$. So we will pass at once to practical details. In the first place, a modern practice—though one I believe not yet generally adopted—is to introduce a certain amount of air to revivify the oxide *in situ*.

Introduction of Air for Revivification.

The two usual methods of introducing air are:

1.—To introduce the air somewhere before—that is, on the vacuum side of—the exhausters.

2.—To introduce the air at a point just before or at the purifiers themselves.

The first method is defective in the following respects. If the vacuum on the main decreases, the amount of air admitted decreases. The opposite occurs if the vacuum is increased; and unless the meter (if there is one) is read very frequently, an excessive amount of air may be introduced, which is a source of trouble. Even granted that the vacuum remains constant, the amount of air introduced will also keep constant, and thus will not vary in proportion to the make of gas. So that the percentage of air admitted will never be constant unless both the vacuum and the make of gas are also constant.

The second method, unless properly applied, would also have the same disadvantages; but the difficulties can be got over in the following manner: Each set of exhausters is provided with a pulley or stepped cone, which drives, by means of a belt, a small exhauster fitted with a counter. The capacity per revolution of this small exhauster is such that, with the gearing provided, the amount of air passed by the blower will be 2½ per cent., or whatever percentage of air it is proposed to introduce. The inlet of the air-blower is provided with a rough screen to catch grit in the air; and on the outlet, or at a suitable point near, it is fitted with an automatic back-pressure valve. A main is run from the outlet to any point where it has been decided to introduce air, which, generally speaking, is just before the purifiers.

If the make of gas increases or decreases, the rate of the exhauster will vary in proportion, and also, as it is driven from the exhauster, will the rate of the air-blower. But suppose you start working into a heavier holder, or anything else alters the back-pressure, What happens then? The exhauster will vary to suit, and so will the air-blower; and as in most works practically all the large variations in back-pressure are caused by the purifiers or holders, the same difference in back-pressure will affect both the exhauster and blower in the same manner. It will thus be seen that the percentage of air introduced is kept practically constant whatever the make of gas or back-pressure; and some years' experience of this method shows that it is automatic in its action, very little trouble to look after, and there has never been any overheating or firing of purifying material. As there is a counter on the blower, and its capacity is known, it is an easy matter to calculate out daily, weekly, or at any time, the percentage of air introduced, as, of course, the gas passed is all measured by the station meter, or, if desired, a meter could be fitted on the air-main.

The idea of the stepped cone is that possibly the percentage of air introduced will require to be varied to suit alterations of plant, &c., but when once set it will adjust itself. In the plant the author has had experience with, there is no stepped cone; but the blower is fitted with a fast-and-loose pulley, so as to be able to stop it at such times as just before stopping, or just after having started the works. A blow-off is also provided on the air-main, so that some may be blown away in exceptional circumstances. This, however, should not be employed if it can be avoided; and in the author's case it has only been used once. It is essential for this method that the speed of the exhauster should be governed, and the bye-pass not used. This is the only efficient way of working exhausters; but special cases, such as where the exhausters are far too large, make working with the bye-pass partly open necessary.

Admission of the Air to the Gas.

If the air is admitted at or near the condenser, a number of undesirable chemical reactions take place before it reaches the purifiers. If the gas is introduced just before the purifiers, at what spot should it be admitted? It has been suggested that it should be introduced close to the clean-water washer, and so carry moisture forward to the purifiers. This is undoubtedly a good point where drying of the purifying material is experienced; but in the author's case, it does not give trouble. The air is therefore introduced into the gas-main just before the Weck centre-valve which controls the four purifiers; so that all the air is introduced into the first taker.

Particulars of Purifying Plant.

In the case under consideration, the boxes are four in number, arranged in two pairs, with common division plates; each box being 36 ft. by 25 ft. by 5 ft. deep, the four boxes being controlled by a 24-inch Weck centre-valve. They are fitted with hurdle grids, and hold 70 tons of purifying material each; the gas entering at the top and leaving at the bottom. Originally the inlet was at the bottom; but the inlet and outlet ducts were recently altered so as to get the first, and therefore most violent, reaction between the gas, oxide, and oxygen over the whole area of the box, and not between the bars of the flat bottom grids. The area of the boxes is according to Mr. Thomas Newbigging's formula—*i.e.*, the maximum daily (twenty-four hours) make of gas in thousands, multiplied by the constant 0·6 = area of each set of four boxes. The maximum daily make in thousands = 1500 × 0·6 = 900 square feet. Boxes 36 feet × 25 feet = 900 square feet. These boxes are in the open air, and are not overhead. They are buried 3 ft. 1 in., and so stand 1 ft. 11 in. clear of the ground; and the spaces between the two pairs and at the outer ends are filled level with the top of the boxes, as also is the space between the set of four and the two catch-boxes, which are 25 feet by 25 feet, controlled by 24-inch four-way valves, fitted with flat grids, and with a light roof over.

The author would like to point out one or two things in favour of this arrangement, leaving first cost out of account. One of the essentials of oxide purification is to prevent the material from getting too cold; and since the boxes are buried except the top and part of some of the sides, they keep warm enough, even in the very worst weather. The following are the temperatures for a year:

Inlet Boxes.	Outlet Catch-Boxes.	Atmosphere.
Maximum 78° ..	Maximum 79° ..	Maximum 92°
Minimum 43 ..	Minimum 36 ..	Minimum 17

In the case of stage-floor boxes, with practically open sides, the material is often cooled-down to far below a satisfactory temperature. It is true that steam coils can be introduced; but, like all other complications, they have their drawbacks.

The oxide-sheds are along one side of the boxes, and the material is taken to and from them by means of skips and runways. As the boxes last many months without changing, the expense is very small, and, in the author's opinion, does not warrant the introduction of expensive elevating and conveying machinery, which would be used very seldom. However, the question of stage or ground floor house is largely a matter of the amount of ground for disposal. In the case in question, the oxide-sheds are over the liquor-wells, which cannot safely be used for many purposes; so that the question of ground area did not come into play. As previously stated, each box holds 70 tons. The revivifying area the author finds desirable for this amount is 6000 square feet. The oxide-sheds have an area of nearly 12,000 square feet, so that the material from two boxes—viz., the spare box and the one being emptied—can be on the floor at the same time.

As the boxes run for a long time, the amount of water due to chemical action, as well as condensation, is necessarily great, and would accumulate in the bottom of the box, and if not removed cause back-pressure. Each of the four boxes and the two catch-boxes are therefore provided with draining pipes, which bring the water by gravity into a common seal-pot, each pipe being, of course, sealed separately.

A battery of six gauges is fixed near the Weck valve—one being from the inlet of the Weck valve, another from the outlet, and the remaining four from the inlets to the boxes. As these gauges are in the open, they are in winter filled with an anti-freezing mixture, which has given no trouble; but the specific gravity of the liquid is not exactly the same as that of water. The back-pressure is taken every day, and so any unusual occurrence is noted. The temperature of the gas in the main inlet to the Weck valve and the outlet from the catch-boxes is also taken daily by thermometers fixed in these mains; the object being to see that the boxes are not getting too hot or too cold.

The catch-boxes are essential to the backward or forward rotation methods, as the first taker has to be altered every few days; and while the valves are being changed the foul gas can, and therefore does, pass straight through the valve. If there were no catch-box or boxes, this would go foul into the holder. This applies to every centre or four-way valve the author knows of; and how some works which have no catch-box manage to keep the gas clean when the sequence is changed or a box put on or shut off, whether the rotation method is used or not, he cannot make out—in fact, he is afraid it must go foul into the holder, if only for a minute or less. So a catch-box is, in his opinion, not a luxury, but an absolute essential if the gas is always to be free from sulphuretted hydrogen.

Unusual Experience during Erection of the Boxes.

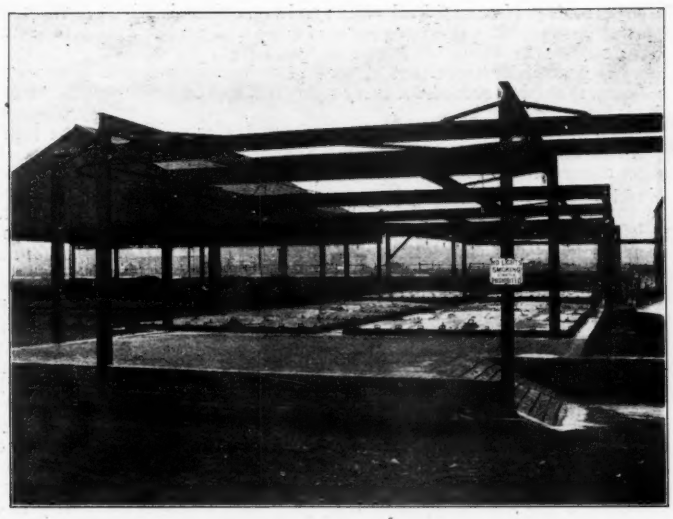
After completing the first two boxes, we proceeded to test them and the Weck valve and connections with air. First of all, pressure was turned on to the inlet main—thus putting pressure on all the inlet valves. The main and valves were then tested with soap and water, and were quite tight, with one notable exception. Air found its way through no less than two out of four of the cast-iron discs of the valves, which are about 1½ inches thick. On testing the outlets in the same manner, two more discs were found defective in the same way. On removing them, it was found that the cast-iron of the discs was porous—thus causing the leaking. They had, of course, to be replaced. The boxes themselves were quite

tight. If the boxes and connections had all been tested together, this peculiar fault would not have been found out; and when foul gas passed straight through the valve, it would be put down to the joint made between the discs and the seats not being sound—thus showing the necessity of carefully testing even the most unlikely places.

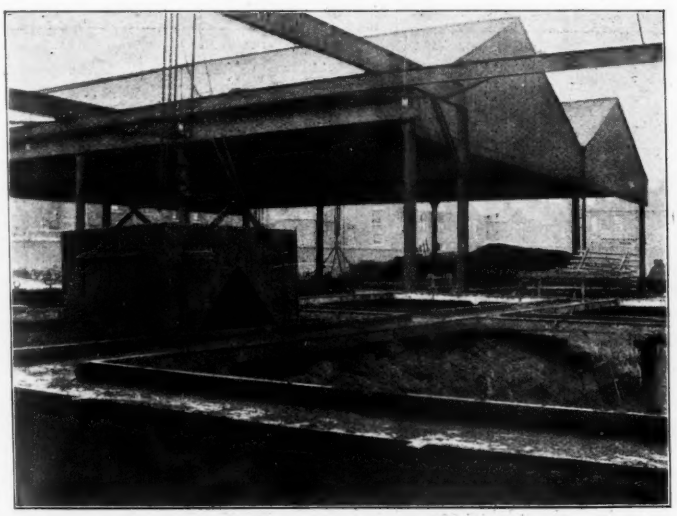
As soon as the first two boxes had been tested, they were filled and put to work. A point may here be mentioned—viz., that although with a Weck centre-valve one, two, or three of the set may be started together before the remainder is complete, after the gas is once passing through the boxes, unless the by-pass be opened and the whole of the connections to the valve isolated, it is necessary to blank-up the inlet to the first, and the outlet from the last, incomplete box of the series before altering the valves for any purpose. This was made evident when it was necessary to start the third box, when one and two were at work and before four was completed.

Method of Working the Boxes.

As soon as the set of four was complete, the rotation method of working was adopted. This, as you no doubt know, consists of working the first taker until it gives a black test with lead acetate paper, and then changing the order of the boxes and putting a clean box on before the fouled one. Sometimes the backward and sometimes the forward rotation method is employed. The author finds them about equally useful; but neither is of much use without the introduction of air for revivification *in situ*. Quite recently it became necessary to stop the meter blower for about fifteen hours; and in this short space of time two of the boxes fouled, showing the necessity of introducing air for revivification.



A General View of the Purifiers.



An Open Purifier, with the Empty and Loading Skip near by.

Procedure before Emptying a Box.

Since starting these boxes, it has been the custom never to shut off a box unless perfectly clean—that is, free from sulphuretted hydrogen. In order to carry this out, at least twelve hours before shutting off the box it is made the last taker, and soon gets clean and partly revivified, and if the spent is left in heaps for a week does not heat or attempt to fire. This applies equally to Lux or artificial oxide in any stage of age, as will be seen from the tables of tests of material removed from the boxes. The reason for emptying the boxes has always been for one of two causes—either the box has thrown pressure or the material has been ready for sending away. Never yet has material been removed because it refused to absorb any more sulphuretted hydrogen.

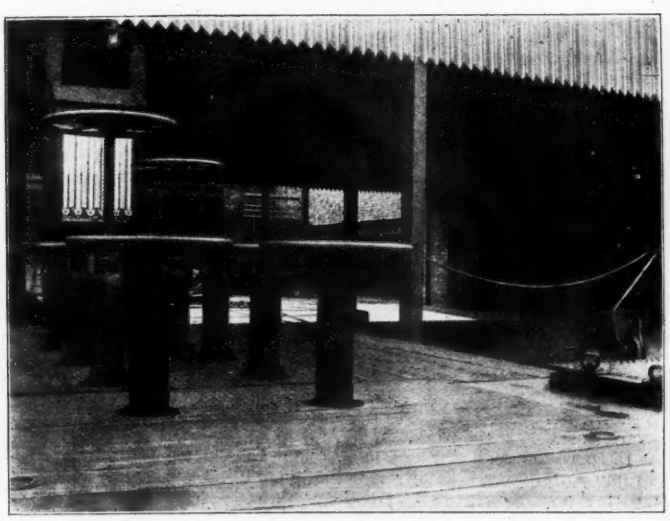
Speaking of back-pressure thrown by a box, the author has noticed that if a box which is throwing excessive pressure as first taker is put on last, the back-pressure thrown by the box rapidly diminishes. So that in every case so far it has been possible, although the pressure thrown by a box may have become excessive, by putting it on as last taker, to choose the time for emptying the box and ensure that the material was free from sulphuretted hydrogen before removing the lids. A box emptied a short time ago, which had been working up-hill for some months and then down-hill for a somewhat shorter period, had a crust of material both at the top and the bottom; the box being emptied, as it was thought advisable to recharge it before the maximum make. On lifting the covers, water was found standing in pools on the top of the caked oxide, which seemed nearly waterproof, as the moisture in the oxide was only 5·09 per cent.

On testing the top and bottom crusts, they were found to contain 50·12 per cent. of sulphur on the wet basis, and 10·47 per cent. of moisture, and so were ready for selling. The remainder of the box was not caked, and only contained 46·34 per cent. of sulphur and 12·34 per cent. of moisture, and thus required reworking. As practically all the spent material was in lumps—and this, from the author's experience, seems the usual condition of highly-charged Lux or oxide—it was decided to screen the oxide; thus removing the spent lumps and obtaining material in good condition for purifying. This was found to be far quicker and better than trying to break the lumps up and re-use the whole of the material; and as a second box is in a similar condition, the two lots of screened material will make a complete box, which will do a lot of work, and probably come out fully charged.

Working New Material up without Changing until It is Fully Charged.

This is no doubt possible under ideal conditions. But is it advisable? It has been brought to notice that the plates of purifiers have been in one or two instances actually broken by expansion of material, owing to the gradual accumulation of free sulphur in the oxide. The cost of once emptying and recharging a box is not so great that it is worth while taking the risk of damaging the purifying plant, let alone the ruining of the grids and the danger of too much use of the pick in breaking up the material.

The moisture in the original material plays a very important part in the working up of material to a high sulphur content without removing the material from the box. New material contains



The Oxide Shed and Weck Valve.

a large percentage of uncombined water; and some of this is driven off during purification. If no sulphur were deposited, the material would decrease in bulk; and as the specific gravity of free sulphur is practically twice that of water, the material can gain 2 per cent. in sulphur content for every 1 per cent. loss of moisture without increasing the bulk.

Mention might here be made of two small appliances which the author has found useful. First, in order to prevent material entering the gas connections during emptying or filling, it is customary to place a plate over the outlet or inlet duct, whichever happens to come to the top of the material. This may be, and in one case was, left in the box when the lids are put on; and thus an unexpected amount of back-pressure was caused, and the lids had again to be lifted. To prevent a recurrence, a handle was fastened on the plate, cranked in such a manner that it was impossible to place the lid in position without first removing the plate.

The second is the form of skip used for emptying and filling the boxes. Originally a tipping skip was employed. But men got their fingers trapped, and the material was dumped too much in one place. So the skip shown in the photos was devised, and has given entire satisfaction. It will be noticed that it is possible with this skip to distribute the material and not dump it all in one place. The mention of unexpected back-pressure reminds the author that when the new boxes were fixed it was deemed advisable, as the water-lute had been done away with and there was thus no outlet in the event of stoppage, to place a safety seal-pot in a convenient position, with such a seal that it would blow before any other seal-pot on the works. This was fixed at the outlet of the tar-extractor.

Tar Fog and Back-Pressure Troubles.

An efficient Pelouze and Audouin tar-extractor, in addition to frictional condensers, is installed; and thus, in the ordinary way, no troubles of this nature occur. On one occasion, however, it was arranged to work up some partly spent material from a small works where evidently the method of removal of tar fog before it reached the purifiers was, to say the least of it, crude and inefficient. This material caused excessive pressure as soon as it was put into use, and in four weeks had to be removed and mixed with other material.

Cyanide.

The installation in question does not include plant for the removal of cyanides, and so a considerable quantity goes to the purifiers, which remove the bulk of it. This may or may not lessen the action of the material. But at any rate it does not greatly interfere with its purifying properties; and the chemical merchants give a considerably enhanced price for spent material containing a recoverable amount of cyanide as prussian blue. So the cyanide is not thrown away. The only material sold up to the present time contained 50·12 per cent. of sulphur on the wet basis, 12·34 per cent. of moisture, 12 per cent. of cyanide recovered as prussian blue, and 0·33 per cent. of ammonium sulphocyanide. Particulars of material used and boxes charged and emptied are given in the accompanying table.

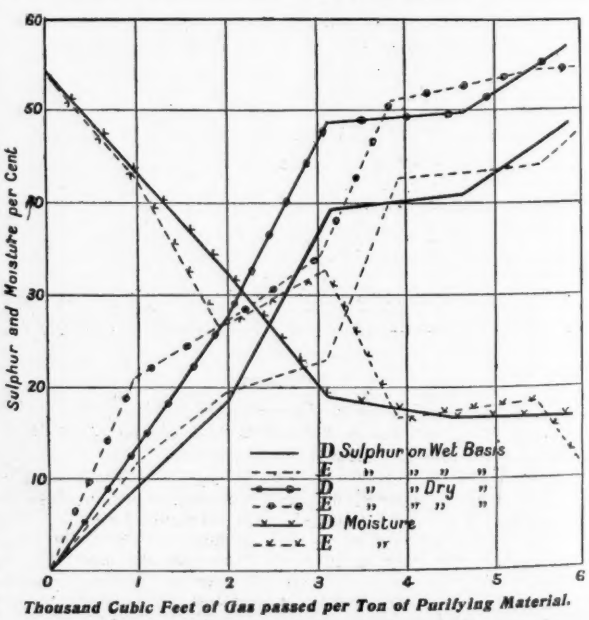
Purifiers Changed Since Starting New Boxes Sept. 21, 1910.

No. of Box.	Date Charged.	Date Emptied.	Material.	Gas Passed per Ton of Material.	Sulphur When Charged.	Moisture When Charged.	Gain or Loss.		Remarks.
							Sulphur.	Moisture.	
					Per Cent.	Per Cent.	Per Cent.	Per Cent.	
1	Sept. 21, 1910	Dec. 8, 1910	Old artificial (A)	1,140,000	..	..	..	..	Sent away
2	Sept. 24, 1910	June 28, 1911	Old artificial (B)	3,504,000	..	..	..	..	Sent away
3	Oct. 8, 1910	April 1, 1911	New Lux (D)	2,084,000	..	54·40	18·72	−21·20	..
4	Nov. 5, 1910	Jan. 6, 1911	New Lux (E)	996,000	..	55·00	12·00	−11·80	..
1	Dec. 9, 1910	Aug. 23, 1911	Old artificial (C)	2,792,000	..	..	..	..	Sent away
4	Jan. 7, 1911	Feb. 11, 1911	Old artificial (F)	510,000	..	..	..	..	Part old, part new
4	Feb. 13, 1911	May 4, 1911	Old Lux (E)	929,000	12·00	43·20	7·18	−16·90	..
3	April 3, 1911	May 20, 1911	Old artificial (F)	376,000	..	..	..	..	..
4	May 5, 1911	Sept. 19, 1911	Old Lux (D)	1,070,000	18·72	33·20	20·53	−13·75	..
3	May 22, 1911	Oct. 19, 1911	Old artificial (C)	1,304,000	..	..	..	..	From catch-boxes
2	June 29, 1911	Dec. 5, 1911	Old artificial (H)	1,786,000	..	..	..	..	..
1	Aug. 24, 1911	Nov. 23, 1911	Old Lux (E)	1,175,000	19·18	26·30	4·24	7·00	..
4	Sept. 20, 1911	Dec. 17, 1911	Old artificial (F)	1,343,000	27·63	15·43	10·96	− 8·26	..
3	Oct. 20, 1911	Jan. 23, 1912	Old Lux (D)	1,499,000	39·25	19·45	2·25	− 2·45	..
1	Nov. 24, 1911	April 17, 1912	Old artificial (G)	2,223,000	32·70	20·78	19·92	−12·79	Sent away
2	Dec. 6, 1911	Jan. 14, 1912	Old Lux (E)	712,000	23·42	33·30	19·36	−16·30	..
4	Dec. 18, 1911	Feb. 13, 1912	Old artificial (H)	1,025,000	..	..	..	..	..
2	Jan. 15, 1912	June 27, 1912	Old artificial (F)	1,828,000	38·59	7·17	9·06	3·30	Part removed to alter inlet and outlet
3	Jan. 24, 1912	July 2, 1912	Old Lux (E)	1,710,000	42·78	17·00	1·21	1·82	Do.
3		Sept. 4, 1912		522,000	43·99	18·82	3·45	− 5·60	
4	Feb. 14, 1912	June 14, 1912	Old Lux (D)	1,209,000	41·50	17·00	6·10	·02	Do.
1	April 18, 1912	June 19, 1912	Old artificial (H)	492,000	38·66	13·98	9·16	1·97	Do.
1		Sept. 16, 1912		749,000	47·82	12·01	3·57	− 4·61	

The method of stating the amount of work done by a certain purifier in a given time—say, from charging to emptying—is often given as so many millions of cubic feet of gas passed; and in reading the discussions of papers on purification the author has noticed emphasis laid on this point, which is really a secondary consideration. The question is, How much work has been done by a box? This is probably best shown by the increase in the sulphur content; but if the amount of gas passed is to be taken as the standard, it should certainly be stated as so many feet per ton of purifying material. Otherwise the area of the box is likely to be overlooked.

The amount of gas passed by the box is defective as a standard for another reason. It gives no indication of the time the box was actually purifying gas—that is, working as first or second taker. A case showing this point up strongly came under the author's notice some time ago. One of the boxes containing old material fouled badly in less than twenty-four hours' work as first taker, while all the other boxes in use would last two or three days in this position. Thus this box spent less than its true proportion of time as first taker, and so, before finally being taken out, had a tremendous amount of gas passed to its credit, but had really done less work than the other more active boxes, which, however, passed a smaller amount of gas. With this point in view, the author drew up the accompanying chart. The first two curves show the percentage of sulphur on the wet basis and the amount of gas in thousands of cubic feet passed per ton of purifying material in the case of two lots of Lux, "D" and "E," and show a gradual increase of the sulphur content, which is not of necessity in proportion to the amount of gas passed. Corresponding curves are also shown giving the increase or decrease in the moisture during the various stages of the working-up of the material.

As the percentage of moisture is very high to commence with, and rapidly decreases, it is obvious that the wet basis is hardly the correct one to use in stating the sulphur content; so the remaining two curves were drawn up showing the percentage of sulphur on the dry basis. It will be noticed that the rapid rise in the sulphur content on both the wet and dry basis gradually tails-off as purification proceeds; and although on the wet basis the final increase seems fairly rapid, it is in reality, in box "E," as much due to the decrease in moisture as to the increase in sulphur—showing the necessity of taking the amount of moisture



into account when comparing apparent increases or decreases in the percentage of sulphur.

Purifying Costs.

Year.	Purifying Cost. Total.	Purifying Cost. Per 1000 Cubic Feet Sold.	Remarks.
	£ s. d.	d.	
1911	77 11 2	0·07	First complete year with new purifiers.
1910	494 12 6	0·45	Purifiers in course of construction.
1909	544 8 4	0·50	Last complete year with old boxes and first with revivification *in situ*.
1908	631 13 8	0·58	" "
1907	626 8 7	0·58	Last complete year without revivification *in situ*.
1901	1171 14 0	1·16	Sulphur compounds removed with lime.

The cost of the four new boxes with 24-inch connections, runways, oxide-sheds, and all foundations, was £7160 18s. 9d. If purifying cost be examined, it will be noticed that, whereas the cost during the year 1911 was only £77 11s. 2d., the cost during 1909 (the last complete year with the old boxes) was £544 8s. 4d.—showing a saving of £466 17s. 2d., which is more than sufficient to pay interest and depreciation on the outlay.

As will be noticed in the table of purifying costs, the introduction of air by means of the meter-blower was started in August, 1908. The last complete year prior to the introduction of air was therefore 1907, when the total cost of purification was £626 8s. 7d., whereas for the first year after its introduction the cost was only £544 8s. 4d.—a saving of £82 0s. 3d. [The rotation method was not in use at that time; being adopted when the new boxes were completed.]

It will be seen from the foregoing that the total saving in purifying expenses of the present system over that in use before the introduction of air is:

	£ s. d.
Saving effected by introducing air	82 0 3
" " " larger boxes with rotation method	466 17 2
Total saving with oxide only per annum	548 17 5
Further saving effected by non-removal of sulphur compounds with lime per annum	545 5 5
Total saving per annum	1094 2 10

or 1·09d. per 1000 cubic feet sold

This shows a total saving of £1094 2s. 10d., or 1·09d. per 1000 cubic feet of gas sold per annum, as compared with ten years ago, when the consumption of gas was much smaller; and the consumers are quite unaware that any change has been made in the method of purification—not a single complaint on this score having been received during all those years.

Firing of Oxide.

A paper on oxide purification is hardly complete without some mention of the firing of the oxide. This can take place when the box is in use purifying gas, during the process of emptying a box, or when the oxide is on the revivifying floor. How can it be guarded against? The author is of opinion that the best method of obviating this difficulty is by the continuous introduction of a suitable constant percentage of air, together with the rotation method of working the boxes.

Firing in boxes while working most often occurs owing to a large proportion of air being inadvertently introduced into a box which previously had none or very little air admitted. Hence very rapid revivification of the accumulated iron sulphide takes place, causing heating and, if not corrected, combustion. In the same way, if no air is introduced and an active oxide is used, on lifting the lids to empty the box, during emptying, or while on the revivifying floor, the oxide (which contains a large proportion of iron sulphide) meeting the air rapidly revivifies, causing heating and, in many cases, combustion. As it has been proved by various investigators that even if air is introduced a purifier containing oxide of iron cannot at the same time absorb sulphuretted hydrogen and revivify the resulting sulphide, it is therefore essential that, after fouling a box, it should be placed with one clean box at least before it, and so be allowed to revivify. For the same reason, a purifier should be put with at least one clean box before it, and be allowed to revivify before lifting the lids to empty it.

Discussion.

After the reading of the foregoing paper at the Leeds Institute last Saturday—with the President (Mr. W. W. Atley) in the chair—the following discussion took place.

The President congratulated the reader on the instructive and interesting paper he had communicated, which was the more valued by them as it embodied much personal experience. They would particularly reflect over the details given as to the saving effected by the changes in purification methods described. He should like to ask at what time the changes in the order of purifier-boxes were made that had been described. Was it when the first showed a foul test, when two or three were foul, or when?

Mr. F. Scholefield joined in appreciating Mr. Townsend's readiness to bring a contribution to their proceedings, so timely and so interesting. He had been struck with what had been told them about back-pressure—that when a purifier box threw an excessive pressure, its order was changed. It was put last, and smooth working ensued. Why did it no longer give back-pressure? Would the same have been the case had no air been admitted for revivification? He had had some trying experiences with back-pressure, especially in winter. Their boxes were too small for the make—24 feet by 16 feet, and passing a million cubic feet a day at the maximum; and they had to change boxes seven times a week. Their new plant was now in operation, and they had only changed two boxes, each of which had passed 18 to 19 million cubic feet, having then to be emptied because of the back-pressure they threw. True, they admitted no air; but he could hardly realize running a box until the sulphur amounted to 50 per cent. He noticed the references were all to the downward travel of the gas. Had they any means of reversing the direction at will? In what condition were the grids when the sulphur had been worked up to 50 per cent. in one fouling? Had they become scorched and charred at all, or had they really managed so to control the heat of fouling and the heat of revivification as to safeguard the grids?

Mr. J. W. Lee said he should like to have seen some statement of the actual proportions of oxygen absorbed in each box. A hint had been given that practically all was utilized in the first. He might venture to remind the last speaker that putting last a box that had previously been throwing too great pressure was quite impossible if no air was admitted along with the gas. He had had some interesting experience of a change of the manner of working. Extra plant for benzol absorption had been put in at some recovery coke-ovens. Previously gas entering the purifiers contained from 2 to 6 grains of ammonia per 100 cubic feet. With the additional creosote scrubber in use, this dropped to ½ grain. The result was that the life of the oxide decreased, and boxes needed quicker changing. Formerly, they worked the sulphur up to 60 per cent. on the dry basis; now they had considerable difficulty in getting it to 50 per cent. The difference might not all be due to the lessened amount of residual ammonia in the gas; but he thought it was. The account of personal experiences with the rotation system was very useful. He had found that occasionally the system seemed to collapse. At night all the boxes might show clean, and yet all be foul next morning. At such times, they had reverted to the old system, until the boxes had renewed regular working, and then they could safely resume the rotation system. It was necessary to lay emphasis on the importance of time-contact—a consideration that in winter was of vital importance. Forcing the boxes, and getting one-and-a-half times the proper maximum of gas through, could hardly fail to entail trouble.

Mr. J. Lang said that he had had a perplexing experience a few weeks previously. His first box showed a blackened lead paper, but subsequently "went clean." As no air was admitted for revivification, his first thought was that some must be getting in unawares. But he could not trace any; in fact, the box never did again show a foul test—having finally to be taken off and emptied, because of back-pressure thrown by it. Oxide did little useful work if it "soured;" and if it seemed to develop no heat when spread out to revivify, not much good was being effected by it. He found he was preparing trouble for himself if he allowed the men to wheel in the oxide and dump the whole barrowful on the bottom of a box 4 feet deep. It became unduly compressed, and soon threw a troublesome back-pressure. His oxide having to be wheeled in, he now arranged for it to be shot down a sloping board, and then shovelled away from its base. By so doing, he got it in an even and not excessive compression, and did not get an irregular passage of gas through the oxide.

Mr. J. Sutton inquired as to how much more material they had managed to get into a box by changing its grids from the horizontal to the hurdle type. At their works they had not been able even to get as much in.

Mr. M'Nab asked how much air the author considered it safe and wise to admit. What was the highest temperature among the oxide in the boxes that could be safely allowed?

Mr. E. Gillett inquired how much sulphur was now found in the purified gas, compared with what used to be found there.

Mr. C. T. B. Roper pointed out that many of Mr. Townsend's advantages accrued from his purifying plant being of ample proportions. Mr. Newbigging's rule for the area of boxes had been given; but not a little diversity of opinion and practice prevailed. The members would find some instructive information on this point in a communication sent by one of their ex-Presidents, Mr. C. J. Sutcliffe, to the "Journal of Gas Lighting" Oct. 17, 1899. In this, he pointed out that some prominent engineers reduced Mr. Newbigging's constant of 0·6 to 0·5, and even to 0·4.

Mr. J. H. Hill gave some details of his own methods and experiences in purification, which had not been greatly modified of recent years—in fact, he still used both lime and oxide. As regarded the question of the amount of material that vertical or inclined grids allowed to be put into a box, he had found he had thus got 28 tons into boxes which with flat grids only held 20 tons each. He had been perusing the author's table of oxide results, and had noticed that he had not sent much oxide away. Was this affecting the costs, and were the economies shown to have been secured entirely real, and irrespective of variations in the material bought and sold in any given year?

Mr. Townsend, in replying to the discussion, stated that it

was their custom as regarded changing boxes to do so when the first one showed a blackened lead paper. In summer, this meant every third or fourth day, and in winter every second day. He admitted being puzzled as to why a box removed from first place because of the pressure it threw, could be safely used as a last box, and was not satisfied he had the correct explanation of it. But the fact was certain that it threw less back-pressure as a last box than as a first, though, of course, still more than the normal pressure. All the inlets were at the top; and they had no means of reversing the flow of gas and making it pass upwards through a box. He had at times examined the gas to find its oxygen content, and as a rule there was about 0·6 per cent. as the gas entered the first purifier and 0·1 per cent. as it left the catch-boxes. They usually put the fouled box into the second position. The great advantage of doing this, instead of putting it last, was that in the latter case the sulphuretted hydrogen of the gas still in the box would be driven into the catch-boxes, and they naturally wished these boxes to remain as long as possible without changing. They had never had such a breakdown of the rotation system as to find all four of the boxes dirty at one time. Usually, they had all four showing clean, or a slight blackening showing with one only. On no more than three occasions had they ever had two showing foul at once. It was not always desirable financially to force too much gas through a box, either as regarded the volume passing in a given time—*i.e.*, in speed—or in the total volume passed. When before their recent alterations they had boxes too small for their requirements, they often changed eight boxes a week, and always had two or three men on night duty for the work; hence the high costs shown. He thought ample size of boxes was a great preventive of firing and over-heating, and that such troubles were quite avoidable if also the rotation system was employed in conjunction with revivification *in situ*. The need of Mr. Lang's device, of sloping boards, was met in most cases by the use of hurdle grids, as with them no undue compression occurred, even when the material was quite roughly dumped in. They had not had any trouble with their grids getting scorched. Breakages occurred, of course, and each time; but they had grids still in use that had been employed continuously for at least five years. Before their new boxes were put in, only the adoption of hurdle grids enabled them to get along at all. They certainly gave much less pressure, and he should say they were able to get about 30 per cent. more material in a box fitted with them than with flat grids. In cases quoted where an opposite experience had been found, it was probably due to differences in local working, and depended on how many layers were used with the flat grids, and thus how many intermediate free spaces there were, and of what depth. He advocated and practised the admission of from 2½ to 3 per cent. of air. Their blower only permitted of 3 per cent. as a maximum. He had never taken any special observations of how high the temperature of the oxide might safely get, as they never had any signs of heating or firing. In fact, he might almost say that they were in so little need of hurrying that they could consult the barometer and wait for a fine day for emptying the boxes. As to the amount of sulphur compounds in the gas, he could give the official figures of the City Analyst. In 1901, the last year with lime purification for the removal of the sulphur compounds, they ranged from 8·48 to 30·3 grains per 100 cubic feet, with an average of 15·4. In 1907, with no lime used, but with no air admitted for revivification, these numbers were from 17·24 to 34·7; the average being 25·5. Last year, with the present method of working, it varied from 17·1 to 35·4, with an average of 20·2. The costs were not unduly favoured by differences in amounts bought and sold. In fact, the inequality told the other way, as they had only sold one lot and bought four. Formerly the material was "on hire."

A cordial vote of thanks was accorded to Mr. Townsend, after warmly appreciative remarks by Mr. Roper and Mr. Hill.

American Commercial Gas Association.

The Eighth Annual Convention and Exhibition of Gas Appliances of the above-named Association will be held in the Auditorium Armoury, Atlanta (Ga.), from the 2nd to the 7th prox., under the presidency of Mr. C. L. Holman, of St. Louis (Mo.). We learn from the programme issued by the Secretary (Mr. Louis Stotz) that after the usual business incidental to the opening of the meeting has been transacted, the following papers will be submitted for discussion:

"Commercialism of the Gas Lighting Industry," by Mr. R. F. Pierce, of Gloucester (N.J.).

"Education of the Employees," by Dr. Lee Galloway, of the New York University.

"Artificial Gas for House Heating, and its Possibilities," by Mr. A. F. Krippner, of St. Louis (Mo.).

"Efficiency in the Advertising Department," by Mr. E. St. Elmo Lewis, of Detroit (Mich.).

"Industrial Fuel as a Revenue Producer, and Methods for the Development of Large Consumers," by Mr. John S. Welsh of the Industrial Division of the Philadelphia Gas-Works.

"Gratuitous Work for Consumers: The Reasons, Precautions, and its Remedies," by Mr. E. C. Weisgerber, of Cedar Rapids, Iowa.

"Sales Campaigns," by Mr. James P. Hanlon, of Newark (N.J.).

The entertainment features of the meeting will include an informal reception and supper, to be given to the members by Mr. P. S. Arkwright, of the Atlanta Gas Company.

POWER PRODUCTION IN GAS-WORKS.

Herr A. Krauss, of Stuttgart, has published an exhaustive communication, in recent issues of the "Journal für Gasbeleuchtung," on the question of power production in gas-works, and especially on the utilization of coke breeze for the purpose.

The author considers that most gas-works have been backward in the utilization of poor fuel. This is partly due to the fact that coke breeze, when used for producing only the power which the gas-works requires for its own needs, does not show a high efficiency; and partly to the fact that, when both the electricity and the gas works belong to the local authority, the gas-works is a desirable customer of the electricity works, and separate power plant is avoided. Not infrequently the water and electricity works of a town utilize fuel according to the latest methods, in order to obtain steam and power at low cost; while in the gas-works belonging to the same authority, no regard is paid to the duty obtained from fuel. In 1908, the Colliery Owners' Association of the Dortmund district set aside a large sum for the investigation of the question of the utilization of poor fuels. This investigation showed that very cheap power could be obtained from poor fuel; and the result will be further centralization of power production, and the use of breeze, blast-furnace gas, and waste heat for the production of that power in connection with the coal and iron industry. So far as gas-works are concerned, the poor fuels of most importance are the coke breeze and the pan and grate refuse from producer furnaces. There is, however, further the question of the utilization of the waste heat from the settings.

The nature and quantity of the coke breeze varies very much in different works, depending upon the description of coal carbonized, the type of retort-setting, and the coke conveying-plant. Generally, it may be screened into three grades—viz. (1) coke dust or breeze, under one-fifth inch in size; (2) small grained coke, one-fifth to nearly one-half inch in size; (3) large grained coke, about one-half inch in size. Frequently, the second grade is not separated from the first. The amount of coke breeze produced ranges from 3 per cent. to 10 per cent. and in some cases to as much as 25 per cent. of the coke produced, or (say) 4 per cent. to 6 per cent. of the weight of coal carbonized. There is naturally more breeze in works which have to store large quantities of coke or break the greater part of their coke before sale. Generally speaking, mechanical conveying plant increases the production of breeze; but at Stuttgart the Illig electric telpher conveyor produces only 3¼ per cent. of breeze, against 4 per cent. for the earlier manual working. Coke breeze contains from 2 per cent. to 10 per cent. of volatile matter, 16 per cent. of moisture, and up to 24 per cent. of ash. The calorific power of the dry coke breeze is from 10,800 to 12,060 B.Th.U. per lb. Residues from the producer furnaces contain much combustible material, and as a rule are thrown on a large-mesh screen, and the clinker picked by hand from the coarse material.

The provision of clinker-screening plant is soon paid for on large works by the saving in wages, and the higher return for coke. Generally, the whole of the refuse passes over a drum screen of about 1-inch mesh, by which the coarse material is delivered on to a band, where it is picked by hand for the removal of clinker. The breeze is removed by a bucket conveyor to storage heaps. If the breeze which has passed through the screen is run on to another screen of one-third to two-fifths inch mesh, the coarse breeze, which is known as clinker-coke, is separated, containing 50 per cent. to 60 per cent. of combustible material, 20 per cent. to 25 per cent. of moisture, and having a calorific power of 7920 to 10,260 B.Th.U. per lb. This fuel is at least as valuable as many inferior coals and lignites which are successfully utilized for power production. The quantity produced is also considerable—viz., at Stuttgart about 1000 to 1500 tons per annum. The fuel thus rendered available is more than is required to supply all the power wanted on the gas-works, and the rest can be sold for various purposes at 2s. to 6s. 6d. a ton. The quantities left for sale will be greater the more efficient the boiler plant and the steam-engines, and the more completely the exhaust steam is utilized. On most gas-works little advantage has been taken of the advances which have taken place in recent years in the development of power. As to the possible economy in the boiler-house and engine-room, it may be mentioned that the introduction of modern plant at the Stuttgart Gas-Works has resulted in a saving of 25 per cent., notwithstanding that the make of gas has increased by 30 per cent., and large washing and bathing installations have been provided for the workmen. More fuel has thus been set free for sale, and the gas-works are endeavouring to dispose of the surplus for public services—such as the water-works, electricity-works, abattoirs, infirmaries, &c. These efforts have, however, so far been in vain, because the boilers at these works are not adapted for the consumption of breeze, and the stokers have become accustomed to the use of high-class coal. For the same reason, it is difficult to find a market for the coke breeze in industrial works. It might well be profitable, however, for the gas-works to utilize breeze on the spot for the production of electrical energy, which would be delivered to the electricity undertaking. As compared with good steam coal, coke breeze yields steam at 60 per cent. lower cost.

The author proceeds to demonstrate, by reference to tables showing the calorific power of different descriptions of boiler fuel

and their cost in Stuttgart conditions, the saving which would ensue if all the clinker-coke produced at the Stuttgart works were applied to the production of power. The saving, compared with the use of steam coal, would amount to about £3000 a year.

Several gas-works have attempted to utilize coke breeze in briquette making; but of the German works of which the costs of such utilization have been published, only that of Riga appears to have achieved success. Most of the other briquetting plants have been discarded. The Colliery Owners' Association of the Dortmund district has, however, made experiments on the manufacture of briquettes from coke breeze and tar-pitch or thick tar, and gives the costs of manufacture per ton of briquettes approximately as follows: For steam, 2d.; wages, 6d.; interest, depreciation, and maintenance, 8½d.; 0·8 ton of coke breeze at 6s. per ton, 4s. 10d.; 0·2 ton of tar-pitch at 9s. per ton, 1s. 9½d.; total, 8s. The briquettes had a calorific power of 10,080 B.Th.U. per lb., and produced little blown ash and smoke on combustion in a Lancashire boiler. These briquettes made with tar-pitch, or thick tar, are not, however, sufficiently firm for transport and break-up rapidly in the fire. On this account, ordinary coal tar pitch has been substituted as a binding material, and the amount required is only half that of the tar-pitch. Thus the cost of manufacturing a ton of briquettes with about 7 per cent. of ordinary pitch at 31s. per ton, will be nearly 9s., and the cost of steam will be approximately the same with these briquettes as with the tar-pitch briquettes. Many breeze furnaces have been designed which fulfil their purpose more or less well.

Fine breeze which ignites with difficulty may be burned with an ordinary grate; but the steam production per square foot of heating surface will be low, and there will be considerable loss of fuel through the fine particles passing through the grate bars. If the spaces between the bars are closed, in most cases the chimney draught will then be insufficient. Consequently, all the boilers for breeze consumption have forced draught in the grates. The air supply and distribution are effected in either of two ways—viz.: (1) The compressed air is brought into the air-tight ash-pit beneath the grate and forced through the spaces in the grate into the layer of fuel, or (2) the ash-pit is left open and air is forced under pressure through hollow grate bars or tubes to supplement the natural draught on the layer of fuel. The air may be compressed by means either of a fan or of a steam-jet. The latter has the advantage that the steam introduced with the air granulates the clinker; but it has the disadvantage of consuming up to 15 per cent. of the produced steam, and of being noisy. With a proper disposition of the air passages, the cost of power for fan working is generally less than for a steam injector. The blast from the fan may be humidified by steam or water in order to break-up the slag and increase the life of the grate. The Dortmund District Association already mentioned has carried out a number of trials with different forced draught and other grates, of which the author quotes the results. These trials, however, were not made in strictly comparable conditions, and hence do not admit of an opinion being formed as to the superiority of one grate over another. It would appear, however, from some of the trials that coke breeze gives a better efficiency the greater the proportion of volatile matter in it. The long flame produced by the volatile matter gives a better transference of heat to the heating surfaces. Thus the coke breeze from retort-settings worked at low heats would be better for boiler-firing than that of more modern settings with higher heats. The coke breeze from the Stuttgart 20 feet horizontal retorts has from 2 per cent. to 4 per cent. of volatile matter or about the same as the coke breeze from coke-ovens. Coke breeze poor in volatile matter, and consequently burning with a short flame, is utilized to better advantage in Lancashire than in water-tube boilers, because the heat radiated from the layer of coke is absorbed more completely by the heating surface of the boiler flues. If, for reasons of space, water-tube boilers must be used, the distance between the grate and the water-tubes should be kept as small as possible. The trials further indicate that a high chimney draught is unfavourable, as the flue gases are thereby carried with such high velocity from the grate to the chimney that they have not time to impart their heat to the heating surfaces.

The author proceeds to quote a few results obtained on gas-works with coke breeze for boiler-firing with forced draught. At the Cologne gas-works, the Perret and the von Wiedenbrück and Wilms grates are used, and an evaporative duty of 43 per cent. to 50 per cent. is obtained; but if the steam used for the blast is deducted, the duty is about 10 per cent. lower. The efficiency is low because a large excess of air is used—the flue gases contain 15 per cent. of oxygen—and there is considerable loss of unburned breeze carried away by the strong draught. The Nuremberg gas-works obtained an evaporative duty of 52½ per cent. with Kudlicz grates, but again the losses through the chimney draught are extremely high. The evaporative duty thus obtained with coke breeze appears low in comparison with the duty of 80 per cent. which is obtained in modern boilers with coal-firing. A careful study should be made of the question of the best manner of utilizing coke breeze as far as possible in existing plant, in order to obtain energy as cheaply as possible from it. This question will involve the consideration of the relative advantages for the production of electrical power of breeze producers and gas-engines and breeze-fired boilers and steam-turbines. It appears to the author that the gas-engine plant is unlikely to give the best solution of the question, if means are found for burning coke breeze with a high duty in steam-boilers.

ANALYSIS OF WATER-GAS PURIFICATION MATERIAL.

By E. C. Uhlig, of Brooklyn (N.Y.).

[Extracts from a Paper submitted to the American Gas Institute.]

Determination of Sulphur.

The material used for the removal of hydrogen sulphide from illuminating gas is known under various names, such as oxide, iron oxide, iron mass, iron sponge. It consists of wood shavings mixed with hydrated iron sesquioxide. After the material has become foul, it is revivified or reoxidized by exposure to the air. Each time the material is used, a sample is sent in for analysis; and thus the action is watched during the life of the oxide. There have appeared from time to time in chemical journals methods for the determination of sulphur; and this research was undertaken to ascertain the comparative value of these methods, having in view the adoption for routine work of a method which would give reasonably accurate results in the shortest space of time.

When the material arrives at the laboratory, it is usually in such a saturated condition, due to moisture and tarry matter, that it must be dried before grinding. One hundred grammes are weighed into a rectangular tin dish and placed in a water-jacketed drying-oven, heated by a steam coil. The temperature is kept between 90° and 95° C.; and when the material is dry enough for grinding, the dish is removed and weighed. The loss of weight is water and light oils. It is unsafe to hasten the drying by raising the heat, as this will volatilize some of the free sulphur of the oxide. The dried mass is next ground in an ordinary drug or coffee mill, and the grinding repeated until it is as fine as possible. By bringing the grinding surfaces closer each time, it is possible to reduce the mass almost to powder.

All the methods of analysis are based on the oxidization of the sulphur and its precipitation as barium sulphate. The methods differed in the manner in which the oxidization was effected. All the reagents employed were tested and found free from sulphur. The distilled water was the product of a continuous steam still, redistilled in a tin-lined copper retort with a block tin condenser. It was also found free from sulphur.

The manner of precipitating the barium sulphate was the same in all the methods. A 10 per cent. solution of barium chloride was added from a burette, 1 c.c. at a time, to the boiling solution. The boiling was continued for ten minutes after the last of the reagent had been added, and the solution allowed to stand over night. Where the precipitation was done in the presence of iron, the barium sulphate was washed with hot 5 per cent. hydrochloric acid until the washings gave no reaction with potassium ferrocyanide, and then with hot water until no reaction was obtained with silver nitrate. It was found that the ignited barium sulphate was liable to be contaminated with iron when the hydrochloric acid washing was omitted.

Methods of Analysis Employed.

Aqua Regia Method as Used in Iron Analysis.—Weigh 1 gramme of the sample into a 200 c.c. Erlenmeyer flask, place a short-stem funnel in the mouth, and add 15 c.c. concentrated nitric acid. Then add 1 c.c. concentrated hydrochloric acid and place flask on a hot plate. From time to time, when the action ceases, add 1 c.c. of hydrochloric acid. When the action has finally ceased, remove the funnel and add 2 to 3 grammes of dry sodium carbonate, wash off the funnel, and evaporate to dryness. Cool, and add 30 c.c. of hydrochloric acid, and evaporate again to dryness. Take up with 50 per cent. hydrochloric acid, boil, and filter. Wash thoroughly with hot water, and precipitate with barium chloride. The undecomposed material on the filter-paper is dried and fused with equal parts of sodium carbonate and sodium nitrate. Boil the fusion in water, filter, wash, acidulate the filtrate with hydrochloric acid, boil off the carbon dioxide, and precipitate with barium chloride.

Fuming Nitric Acid Method.—Digest 1 gramme with 50 c.c. of fuming nitric acid in a 200 c.c. Erlenmeyer flask, and evaporate on a hot-plate or sand-bath to half its volume. Add cautiously 3 grammes of potassium chlorate, and evaporate to dryness. Bake on the hot-plate for half-an-hour. Cool and add 30 c.c. of 50 per cent. hydrochloric acid. Boil and filter. Wash with hot water, and precipitate as described above. The undecomposed matter is to be fused and treated as described in the aqua regia method.

Sodium Hydroxide Method.—Boil 1 gramme in a porcelain casserole with 50 c.c. of a saturated solution of sodium hydroxide. Wash into a 500 c.c. flask, and add sufficient crystals of potassium permanganate to give a red colour. Add 100 c.c. of concentrated hydrochloric acid, boil off the chlorine, dilute with water, and filter. Wash, filter, and precipitate as above.

Fusion Method as Used for Sulphur in Coal.—One gramme of the sample was mixed with 10 grammes of sodium carbonate and 10 grammes of sodium nitrate. The mixture was well ground in a porcelain mortar, and transferred little by little to a red-hot platinum crucible. The crucible was well covered at each addition, and kept covered until the contents were in a state of quiet fusion. The contents of the crucible were boiled in water, acidulated with hydrochloric acid, and evaporated to dryness, taken up with hydrochloric acid, and filtered. The filtrate was precipitated with barium chloride.

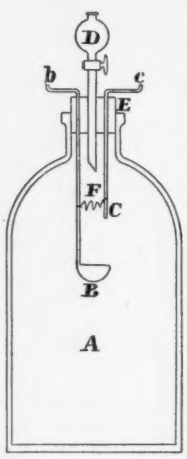
Eschka's Method.—Mix 1 gramme in a large platinum crucible

with 10 grammes of calcined powdered magnesite, and 5 grammes of dry sodium carbonate; cover with a little of the mixture, and heat gently for about 30 minutes; then increase the heat until the crucible is red-hot, and continue heating with occasional stirring until no black particles remain. Empty the crucible into a 200 c.c. beaker, and wash it with hot water into the beaker. Add sufficient water to make the volume about 100 c.c., and boil about half-an-hour. Filter, and wash three times by decantation with hot water. Add to the filtrate a slight excess of bromine water, make acid with hydrochloric acid, boil, and precipitate with barium chloride.

Combustion in a Calorimeter Bomb.—Mix 1 gramme in the bomb of a Parr calorimeter with 2 grammes of finely powdered potassium chlorate, and 10 grammes of sodium peroxide. Adjust the firing-wires, screw on the cap, and place the bomb in a beaker of water. Effect the combustion by means of the electric spark, as usual; and when the bomb is cool enough to handle, unscrew the cap and wash out the contents with cold water into a 150 c.c. beaker. Acidify with hydrochloric acid, boil, and filter. Precipitate the filtrate with barium chloride, as usual. Fuse the undecomposed part as under the aqua regia method.

Modifications of the Preceding Method.—The contents of the bomb were boiled with water and filtered. The insoluble part was boiled with 25 per cent. of hydrochloric acid and filtered; the part remaining undecomposed being fused as under the aqua regia method. The sulphur was determined in each part.

Graefe's Method.—Weigh half a gramme on to a 9 cm. filter-paper; fold the paper round the sample, and place it in the combustion spoon B. Fasten a piece of cotton string from the paper to the firing-wire F, and place the whole in the 8-litre bottle A, which contains oxygen. Firmly fasten the stopper E with the clamp, and connect *e* and *b* with an electric battery. When the sample has finished burning, place the bottle under a tap and cool by running water over the surface. When cool, add 50 c.c. of a 10 per cent. solution of sodium peroxide by means of the funnel D. Remove the stopper E, and wash the combustion spoon into a 500 c.c. beaker. Pour about 100 c.c. of water into the bottle, shake it round, so as to wet the inside surface, and pour it into the beaker. Wash the bottle several times with small volumes of water; pouring the water each time into the beaker. With care, the washings may be kept down to about 300 c.c. Filter, acidify with hydrochloric acid, boil, and precipitate with barium chloride.



Extraction with Carbon Disulphide.—Weigh the gramme on to a filter-paper. Wrap the paper round the sample, and place it in a Soxhlet extractor, having previously weighed the flask. Extract with pure recently distilled carbon disulphide until colourless. Remove the flask, and distil off the carbon disulphide; expelling the last traces with a current of filtered air. Weigh the flask; the increase of weight is sulphur and tar. Oxidize the contents of the flask with fuming nitric acid, and determine the sulphur as usual. The weight of sulphur subtracted from the weight of the contents of the flask will give the tar. This method gives only the free sulphur. To determine the condition of the remaining sulphur, the method was carried further, as follows: The filter-paper and contents were placed in an evolution flask, and treated with dilute hydrochloric acid; the evolved gas being absorbed in bromine in a ten-bulb Meyer tube. This gave the sulphur present as sulphide. The solution in the flask was filtered from the undecomposed matter, oxidized with bromine, and the sulphur determined. The insoluble matter remaining was fused as already described under the aqua regia method.

*Lunge's Method as given in "Technical Methods."**

Weigh 0·5 gramme into a porcelain boat and place it in a glass combustion-tube, which is connected to bulbs containing bromine. The combustion was effected in a current of moist oxygen. The sulphur absorbed by the bromine was determined.

Results of Analyses.

Oxide No. I.

[Sulphur determined by the following methods: Aqua regia, sodium hydroxide, fusion, bomb, Graefe, Eschka.]

	Aqua Regia.	Sodium Hydroxide.	Fusion. (a)	Fusion. (b)	Fusion. (c)
S in solution	23·040	23·114	23·08	23·23	22·62
S in residue	0·038	Not deter...	None	None	None
Total	23·078	23·114	23·08	23·23	22·62

	Bomb. (a)	Bomb. (b)	Graefe.	Eschka.
S in solution	22·738	23·023	22·676	21·359
S in residue	0·213	0·115	Not determined.	
Total	22·951	23·138	22·676	21·359

All these methods, with the exception of Eschka's, give quite close results. This method yields accurate results when used for the determination of sulphur in coal, and the low figure obtained may be due to some sulphur escaping during the heating. The sodium hydroxide and fusion methods are accurate, but rather too troublesome for routine work. The bomb and the Graefe methods are accurate and rapid; the solution being ready for precipitation an hour after weighing-out the sample in Graefe's method, and in about half this time in the bomb method. The aqua regia method is accurate; but the evaporation consumes much time. It was thought that this might be dispensed with. It was tried, with the following results on the same oxide:

S in solution	23·832	23·134	22·008	23·569
S in residue	0·151	0·652	1·804	None
Total	23·983	23·786	23·812	23·569

These results are all higher than when the solution was evaporated to dryness; the difference being due to silica which precipitated with the barium sulphate. There were even evidences of flocculent silica in the solutions before precipitation. The silica was determined in the fusion method, sample *b*, and was found to be 2·01 per cent.

The following was tried on a sample of a different oxide:—

[Methods used: Fuming nitric acid, Graefe, extraction, and Lunge.]

Oxide No. II.

	Fuming Nitric Acid.	Graefe. (a)	Graefe. (b)
S in solution	20·60	20·42	20·54
S in residue	None	Not done	0·06
Total	20·60	20·42	20·60

	Extraction.	Lunge.
S extracted	18·49	Sulphur driven off by heat and absorbed in 18·72 bromine.
S evolved by HCl	0·11	
S in combination, soluble in HCl	0·38	The remaining sulphur not determined.
S in residue	1·59	
Total	20·57	

The above shows that the Graefe and fuming nitric acid methods give practically the same results. The extraction method is very slow. This particular extraction occupied two days before the carbon disulphide was colourless, probably due to the tarry matter, which was found to be 10·71 per cent. The Lunge method was quite rapid; the solution being ready for precipitation in a little more than an hour.

As the object of the analysis of purification material is to determine the sulphur which is removed from the gas, it will be seen that the total sulphur in the oxide is wanted, irrespective of the state of combination. Therefore the extraction and Lunge methods do not give the information desired, but rather the percentage of free sulphur. These two methods would seem to be suitable where the oxide is sold for its free sulphur content. This, however, is not the question here. The information sought is: What work is the oxide doing? This question, as stated above, involves the total sulphur.

Of all the methods considered, that of the bomb gives accurate results with the least expenditure of time. There is, however, the question of initial cost. The Graefe method, while taking longer than the other, gives results sufficiently accurate, and the initial cost is quite low. The apparatus may be assembled from materials usually found in laboratories.

Determination of Tarry Matter in Water-Gas Purification Material.

For this purpose two methods have been used:

(1) Weigh 10 grammes of the dried material into a weighed Soxhlet cartridge that has been previously extracted with carbon disulphide; place it in an extraction apparatus, and extract with carbon disulphide until the solvent is colourless. Remove the cartridge, allow it to dry, at first spontaneously and finally in a current of dry air. Weigh the cartridge. The loss will be tar *plus* the soluble sulphur. Weigh 2 grammes of the material remaining in the cartridge, and determine the sulphur in it. This gives the fixed or insoluble sulphur. We now have: Total sulphur as determined on an unextracted portion *minus* the fixed sulphur above gives the soluble sulphur; tar *plus* soluble sulphur *minus* soluble sulphur gives the tar.

(2) Weigh 2 grammes on to an 11 cm. filter paper; fold the paper, and place it in an extraction apparatus. Weigh the flask of the apparatus, and extract with carbon disulphide until colourless. Remove the flask, and distil off the carbon disulphide. Expel the last traces with a current of dry air. Weigh the flask. This gives the tar *plus* the soluble sulphur. Determine the sulphur by oxidation with fuming nitric acid and precipitation with barium chloride. This result deducted from the previous one gives the tar.

The second method occupies less time than the first. In both methods it is necessary to enclose the material, so that the woody portion cannot float in the solvent and be carried down to the flask. This is done by placing a wad of cotton in the cartridge in the first method, and in the second by tightly wrapping the material in a filter-paper.

The extraction of this material and the subsequent determination of the sulphur is a time-consuming operation; and it was thought that some solvent could be obtained which would remove the tarry matter and leave the sulphur behind. The following

* See Part I., Vol. I., p. 270.

were tried: Carbon tetrachloride, toluol, petroleum ether (sp. gr. ·636), acetone, and ether.

Before beginning the extraction, it was thought advisable to make comparative qualitative experiments on the solubility of sulphur in the solvents. This was done by treating 1 gramme of re-sublimed sulphur in a test-tube with about 20 c.c. of each solvent. The following were the results: Carbon disulphide completely dissolved the sulphur in the cold; carbon tetrachloride partially dissolved the sulphur on boiling; toluol completely dissolved the sulphur on boiling; petroleum ether, acetone, and ether all partially dissolved the sulphur on boiling.

This disposed of the attempt to extract tarry matter without at the same time removing the sulphur from the material; and it only remained to find a solvent which would take the place of carbon disulphide, which is somewhat dangerous to use on account of its inflammability. The qualitative tests having shown that sulphur was partially soluble in all the solvents, it was evident that if the extraction process were continued long enough, all the sulphur would be removed, and possibly all the tarry matter.

As petroleum ether and ether are also very inflammable, there was no advantage in their use; and there remained only carbon tetrachloride, acetone, and toluol. As a matter of interest, all the solvents were tried with the following results:

Oxide A.

[Total sulphur previously found, 15·91 per cent.]

	Carbon Disulphide. Per Cent.	Carbon Tetrachloride. Per Cent.	Petroleum Ether. Ether. Acetone.
Soluble sulphur	12·92	12·69	Extraction very slow and incomplete; only the lighter oils of the tar were removed.
Fixed sulphur	2·99	3·22	
Tar	9·74	9·17	

Oxide B.

[Total sulphur previously found, 21·72 per cent.]

	Carbon Disulphide. Per Cent.	Carbon Tetrachloride. Per Cent.	Toluol. Per Cent.
Soluble sulphur	17·80	17·82	18·47
Fixed sulphur	3 92	3·90	3·25
Tar	9·56	8·21	9·03

Oxide C.

[Total sulphur previously found, 14·17 per cent.]

	Carbon Disulphide. Per Cent.	Carbon Tetrachloride. Per Cent.
Soluble sulphur	11·13	11·52
Fixed sulphur	3·05	2·65
Tar	9·91	8·05

The foregoing results would indicate that petroleum ether, ether, and acetone would not answer, as they do not remove all the tarry matter. The extractions with these solvents were carried to a point where the solvents were not coloured by contact with the material, and it was plainly evident that only the lighter oils were removed; so the operations were discontinued.

Toluol is a good solvent for both sulphur and tar. Its vapour is inflammable. But the high boiling-point (111° C.) makes it easy to condense; so there is not much danger on this account. It is better adapted to the first method than to the second, because in the latter the high boiling-point may cause a loss of both sulphur and light oils when the solvent is distilled off from the contents of the flask. It is slower in its action than carbon tetrachloride or carbon disulphide. The former is a very good solvent. It is more rapid than toluol, but slower than carbon disulphide; and its non-inflammability makes it very safe to use. Carbon disulphide is the best solvent. It may be safely used, provided precautions are taken. By heating the flask on a small sand-bath with a low flame, and having a long air-condenser over the extractor condenser, none of the vapour will escape at the top. Its low boiling-point (46° C.) enables the expulsion of the last traces to be readily accomplished. It is best to use it freshly distilled to ensure its freedom from sulphur.

The extraction of purification material, no matter what solvent is used, is a lengthy operation; and it is difficult to determine when it is complete. It was noticed that when the extraction had been proceeding for several hours after the solvent had become colourless, on turning out the light and allowing to stand all night, the solvent around the cartridge would be found coloured in the morning, indicating traces of tar. To test the completeness of the extraction, successive solvents were tried, viz.—

Oxide D. (Two Tests).

I.—Extraction with CS_2 followed by CCl_4.
II.—Extraction with CCl_4 followed by CS_2.

	Grammes.		Grammes.
First extraction—		First extraction—	
Material taken	10·000	Material taken	10·0000
Removed by CS_2	2·157	Removed by CCl_4	1·9145
Second extraction—		Second extraction—	
Material from first taken.	5·921	Material from first taken	6·08
Removed by CCl_4.	0·162	Removed by CS_2	0·0995

Either the carbon disulphide or the carbon tetrachloride methods may be used for works control. The latter is about 50 per cent. longer in time than the former. The length of time depends, of course, on the percentage of sulphur and tar. Usually an extraction started at 9 a.m., and allowed to proceed until the next day at noon will be complete enough for practical purposes.

The attempt to remove tar without at the same time removing sulphur was a failure, because every solvent tried removed some sulphur. Sulphur evidently exists in the purification material from carburetted water gas in combination with iron and with tarry matter, as well as uncombined, and possibly dissolved in the tarry matter.

A New American Gas Publication.

We have received the prospectus of a new publication devoted to the gas industry which is to make its first appearance next Monday, and continue fortnightly. Its title is "The Gas Record," and it will be issued by the Gas Publishing Company, of Monadnock Block, Chicago, at the price of $2 per annum. It is stated that "the contents of the new journal will be a stimulant to expansion and improvement in the plants of its readers;" they will be "diversified and well balanced;" and those who peruse them "will be informed on every activity of the field." The news will be condensed, and yet "all there;" and the editorial politics will be "right." According to the projectors of the publication, it is going to be "a great new constructive force in the gas field." It will "grip the gas man's interest, and hold it by talking to him intimately about timely topics which most affect his occupation and prosperity." The "stars" in the gas business who are "not strong in the literary art, or in writing about their work, their methods, &c.," will be interviewed by a representative of the "Record;" and it is confidently believed that the result will be "a wealth of unique and absolutely exclusive material which every gas man will devour with interest." "After all," says the prospectus, "practical stuff is 'the real thing,' and cannot be beat." The first issue of the new publication will be distributed at the meeting early next month of the American Commercial Gas Association at Atlanta, the programme of which is given elsewhere; and the second, which will appear on the 10th prox., will, we are told, contain "a snappy account of the convention, profusely illustrated with pictures of those who were there." The preceding extracts from the prospectus give an indication of the scope of the new publication and of the spirit in which it is planned to be conducted. We shall await with some interest its bi-monthly appearance, to see how far the promises of its projectors are carried out, and their aspirations realized.

A Baronet-Solicitor Tout.

This was the heading to a paragraph in last week's "City Notes" of "John Bull"—dealing with a matter to which attention was drawn in the leading columns of the "JOURNAL" for Oct. 29, p. 342. Our contemporary wrote: Our attention has been called to a circular recently issued by Sir Charles Buckworth Herne-Soame "(Baronet) Solicitor (retired)," of 115 and 117, Cannon Street, E.C., stating that he had been instructed to realize "a 6 per cent. and 7 per cent. gas-works security." Enclosed in the circular are printed particulars of a Company called the (New) Toddington and District Gaslight and Coke Company, Limited. Sir C. B. H. Soame, Bart., &c., has been offering shares in the Company for the past three-and-a-half years. In March, 1909, he was also offering them as Chairman of the Water and Gas Debenture and Share Investment Trust, Limited, which was then guaranteeing "a dividend of 6 per cent. on the preference shares then offered, for a period of two years," which would take us to March, 1911. In the latest circular we read that the interest on the shares is to be guaranteed, but the name of the guarantor is not given. The name of Sir Charles B. H. Soame, "Bart. Solicitor (retired)," is familiar to us as being that of a gentleman who has identified himself somewhat frequently with the creations of the Edmund Eaton stable. One of the more notorious enterprises was the Patent Block-Tar Motor-Oil and Asphalte Company, Limited, of which Sir Charles was, at one time, the Chairman. After the Company had done a little touting on its own account, he took the circularizing into his own hands last year, when he considered that its £1 paper would go to £6. But they were still being offered by the Company at par so recently as September of this year. Then there was Sir Charles's association, as Director, with the Beet Sugar Development Company of England, Limited, another Edmund Eaton creation, which issued a prospectus in June, 1910. The exact whereabouts of the offices of this Company do not appear to have been ascertained by Somerset House. The registered offices in July of last year were returned as Brewer Street, London, which, in view of the fact that there are several streets of that name, is somewhat vague. We have shown Sir Charles's connection with three Eaton promotions. As to the standing of Mr. Edmund Eaton, we shall allow Sir J. Hawtrey Cox, Bart., to speak. Sir Hawtrey was one of the Directors of the Suddine Fuel Company, and he was also on the Board of another Eaton concern—the Brighton, Eastbourne, and Bognor Crystal Water Company, Limited. There came a time when, to quote his own words, he "could not reconcile his business ideas to those of Mr. Edmund Eaton and his friends," who, so it appears from Sir Hawtrey, were stated to him to be "reliable persons, with considerable capital behind them." But Sir Hawtrey states: "This I now know was not a fact."

The Torquay Town Council have increased the salary of the Water Engineer, Mr. S. C. CHAPMAN, M.Inst.C.E., by £50 per annum, in consideration of his services in the construction of the Trenchford reservoir, the provision of filters, and other works for the improvement of the water supply of the town.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

The Koppers Chamber Ovens at Vienna.

SIR,—Your correspondent, Mr. Cooper, disposes too lightly of my remarks on this subject. He accuses me of misusing Coste's figures for the calorific value of the constituents of coal gas, without apparently having referred to Coste's book to see whether that were so or not.

The fact is I did not employ Coste's values for gas at 0° C., as he infers, but those for 15° C. and moist, in order to correspond with the figures given for the observed calorific power. Moreover, your correspondent is quite at sea in the relationship he conceives to exist between the two values. Had I used the figures for 0° C., as he suggests, the factor required for conversion would have *reduced* my result, not *increased* it, as he implies.

Mr. Butterfield virtually confirms all that I contended for in my letter. Because, although he assigns to the heavy hydrocarbons a value that is rather higher than the figure I employed, the total is thereby raised by only some 10 or 11 B.Th.U. The point is of no material importance, for every gas will differ slightly in this respect. But I may say that, in my own experience, I have found the value adopted by Coste to approach more nearly to the observed result than does Mr. Butterfield's.

With regard to the suggestion that errors in a technical analysis may have something to do with the discrepancy, I would point out that it is not merely one analysis or determination which is in question, but an average of six. As to the further suggestion that the bulk of the heavy hydrocarbons may consist of benzene, it is a matter which could surely be brought to the test of actual determination; and, if those in charge of the plant have any confidence in the suggestion, it is a research they may deem worth undertaking. But who ever heard of a coal gas containing nearly 3 per cent. of benzene?

J. T. S.

Nov. 14, 1912.

SIR,—In connection with the recent letter of "J. T. S.," *re* the discrepancy between the calorific value of gas as recorded by a calorimeter and as calculated from the analysis, my experience is that a difference of 10 per cent. between the two values is often to be found. Furthermore, in the case referred to, the calorific value was recorded continuously; and 612 B.Th.U. was an average. On the other hand, probably the analysis of the gas was made only once per day; and hence the gas so tested may have been below the average. A very little increase in the C_nH_m content makes a great difference in the calorific power. Again, as Mr. Butterfield points out, the calorific value used for C_nH_m may also make considerable difference in the final result.

Anyone who has to deal with gas will admit that, for all practical purposes, a calculated calorific value is of little use as against the value obtained by a good calorimeter. In the present case, the calorific value of 612 B.Th.U. was recorded by a standardized Junkers calorimeter; and it is, therefore, safe to assume that either the analysis given did not represent the average composition of the gas or that the values used in calculating the calorific value were not sufficiently in accord with the composition of the C_nH_m constituents.

A. D.

Nov. 14, 1912.

Benzol for Motor Fuel.

SIR,—In the article in the current issue of the "JOURNAL," on the "Recovery of Benzol from Coal Gas and its Use as a Motor Fuel," it is not mentioned in the detailed description given that the crude benzol, which is directly distilled from the creosote oil, has to be washed with acid before it is redistilled, to obtain the purer product. This is important, as the former benzol would be unsuitable for pleasure cars, on account of the noxious smell.

The employment of benzol as a motor fuel should not be prejudiced at the outset by the use of an unwashed product.

What is known as "90 per cent. benzol" is always a washed product, and is the one so far that has been most used as a motor fuel.

There is, however, a newer and better product being made at some coke-works—a 100 per cent. benzol—that distils off at or about 80° C.; and doubtless much more will be heard of this in the future.

H. W. SEYMOUR.

Leeds, Nov. 13, 1912.

Dr. W. B. Davidson's Studies in Carbonizing.

SIR,—The discussion on these important studies includes mention of all vertical retort systems save Dempster's system of intermittent vertical retorts, which has been working since 1909 at the Cleethorpes Gas-Works. I therefore beg leave to add a few remarks.

In the discussion, Mr. J. Ferguson Bell says, "that the methods of charging Dessau vertical retorts required modifying, inasmuch as the existing method was productive of a too dense coke and an excessive gas pressure within the retort, which criticism he made in the hope that the Dessau system might be improved and modified to suit the conditions that prevailed in this country."

The above exactly expresses the view I held in the year 1908, when I placed an order with a British firm for a system of intermittent vertical retorts to suit British conditions. The Cleethorpes installation—to put the matter concisely—has only 7·10ths pressure at the bottom of the charge for a short period. The coke is not as dense as Dessau coke; and owing to the more lightly-laid charge, there is more shrinkage of the charge of coke and more ready discharge.

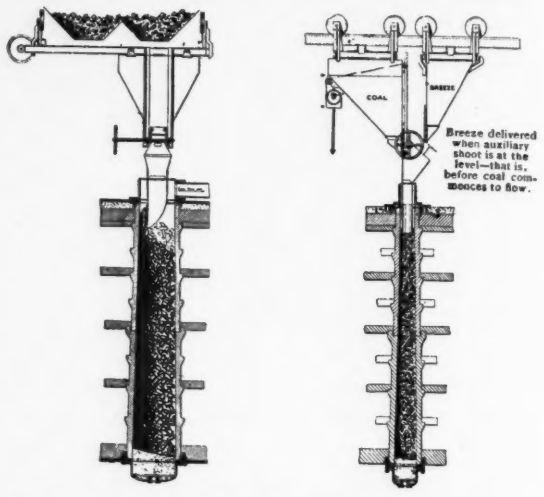
This improved system was fully described in the "JOURNAL;" and the system, if given a fair field and no favour, will more than hold its own in its applicability for home conditions.

Dr. Davidson also disapproves of the use of Dessau pitch-pans. I have been working now for three years and have never used them, and rely chiefly on a continuous flow of liquor or tar through the hydraulic mains.

If I may add my experience to others with regard to the causes of thick tar and pitch in the hydraulic mains, I am of the opinion that in horizontal retorts the material removed when cleaning the ascension pipes falls into the mouthpieces and is lost sight of among the coke and coal; whereas in vertical retorts, the same dirt from clearing the pipes, falls into the hydraulic main, and is thus largely contributory to the formation of the hydraulic main deposit.

E. J. BROCKWAY.

Cleethorpes, Nov. 14, 1912.



Toogood's Patent Automatic Shoot—to build porous charges from unscreened coal and cause each retort to measure its own charge.

P.S.—It might be well here to reproduce from the "JOURNAL" of June 4 last an illustration of the shoots whereby, during charging, the momentum of the falling coal is absorbed, first on the inclined shoot and secondly on the inclined bank of coal, the nuts gently rolling down the incline and coming to rest gently and lightly at the opposite side of the retort.

The Working of Vertical Retorts.

SIR,—I have read with interest Mr. Nelson's letter published in your last issue, which is both welcome and opportune, in further avoiding such condemnation of the Dessau system of vertical retorts by laying at its door—as was attempted at the Birmingham meeting—something which never happens.

The diagram given by Mr. Drury in his paper last year was strongly supported by the more recent chart given with Mr. Nelson's paper at Newcastle in May last. In both diagrams, it is clearly shown—just the same as in horizontal retort practice—that a back-pressure is generated from 2 to 5 inches immediately following the charging of the retort, and also that in a short time this maximum pressure disappears altogether to an even, level gauge, as Mr. Nelson's chart shows.

Mr. Bell's fears as to the "packing" of the charge by momentum, *plus* weight, must be somewhat allayed on reading Mr. Nelson's letter, and particularly one part of it—viz., "The density of the charge is proportionate to the mass liberated per second, or the time occupied in charging." The following figures will prove something towards the density of the charge in proportion to the mass liberated per second. The retort being of tapered dimensions throughout its length, the momentum is reduced in ratio to the height and cubical capacity to be filled. The average time for charging (regulated by different men) is taken at 25 seconds.

Charging Dessau Vertical Retorts.

Feet.	Coal (lbs.) Put in Retort.	Time Taken. Seconds.	Cubic Feet Occupied.
1			
2	102	3·10	1·97
3	99	3·01	1·89
4	94	2·70	1·77
5	89	2·61	1·71
6	85	2·50	1·62
7	80	2·46	1·54
8	77	2·25	1·48
9	74	2·20	1·42
10	72	2·17	1·34
11	68	2·00	1·27
	840 lbs.	25·00 seconds	16·01 cubic feet

It will be seen that, with the largest capacity to be filled, there is only a "showering" of coal—approximately 33 lbs. per second—not dropped as a "falling body," but run down at an angle in excess of repose, in consequence of the delivery of coal being guided against the side of the retort.

These particulars are given with full knowledge, and from careful observation extending over many months working a large installation of Dessau vertical retorts.

CONSISTENCY.

Nov. 15, 1912.

Bourne District Council and the Gas and Water Works.—At the meeting of the Bourne Urban District Council last Thursday, the Clerk (Mr. S. R. Andrews) read letters from the Bourne Gas and Water Companies in reply to the inquiry whether they would sell their undertakings to the Council. The Directors of each Company said they would be prepared to recommend the shareholders to sell on an arbitration award. Both letters were referred to the Lighting Committee.

PARLIAMENTARY INTELLIGENCE.

GAS AUTHORITIES AND RESIDUAL PRODUCTS.

JOINT COMMITTEE OF PARLIAMENT.—Tuesday, Nov. 12.

[*Before Mr.* HILLS, *Chairman, Earl of* CRAVEN, *Lord* HOWARD DE WALDEN, *Lord* PLUNKET, *Mr.* LARDNER, *Mr.* WALTER REA, *Mr.* SAMUEL ROBERTS, *and Mr.* GEORGE THORNE. *Lord* BRAYE *and Lord* INCHCAPE *were absent.*]

The Joint Committee of the Houses of Lords and Commons appointed to consider whether any, and, if any, what, restrictions should be imposed on gas authorities with respect to the purchase and manufacture of the residual products resulting from the manufacture of gas by other gas authorities, or of other chemicals, held a preliminary sitting to-day, to elect a Chairman and decide upon procedure. When the parties were admitted to the Committee-room, it was seen that Mr. Hills had been elected to the chair.

The Counsel present were: Mr. J. D. FITZGERALD, K.C., for the United Alkali Manufacturers' Association; Mr. BALFOUR BROWNE, K.C., Mr. C. C. HUTCHINSON, K.C., and Mr. A. M. PADDON, for the Gas Companies' Protection Association; and Mr. PRITCHARD (Messrs. Sharpe, Pritchard, and Co., Parliamentary Agents), for the Association of Municipal Corporations.

The CHAIRMAN, at the outset, said that Mr. Thorne, a member of the Committee, had asked him to mention that he was Vice-President of the Association of Municipal Corporations, who were one of the parties asking to be heard by Counsel before the Committee. He understood that Mr. Thorne was Vice-President in respect of Wolverhampton, of which he had been Mayor; but Wolverhampton was not a borough which manufactured gas municipally. He took it, therefore, that there would not be any objection to Mr. Thorne sitting on the Committee.

Mr. FITZGERALD said he was perfectly certain the Alkali Manufacturers, though he had not consulted them, would raise no objection whatever to Mr. Thorne sitting on the Committee.

The CHAIRMAN said the Committee were prepared to hear Counsel on behalf of the Association of Municipal Corporations, the United Alkali Manufacturers' Association, and the Gas Companies' Protection Association. The Committee thought it would be convenient to proceed on the same lines as in the case of a Private Bill. They would, in the first instance, hear speeches and evidence on behalf of those who sought to restrict the purchase and manufacture of residual products, and they would then hear arguments and evidence from those representing the gas undertakings. In conclusion, they would hear a reply from the parties who opened. It was proposed to sit from 11 a.m. till 4 p.m., with an adjournment for luncheon, on Tuesdays, Wednesdays, and Thursdays.

Mr. BALFOUR BROWNE said, of course, he had no comment to make upon what the Chairman had stated; but he would ask that the Tuesdays, Wednesdays, and Thursdays should not be immediate, because they were all not really in a position to go on at once. He was appearing for the Gas Companies' Protection Association, and he understood an application was to be made to the Committee on behalf of the Association of Municipal Corporations, because since they had known of this inquiry they had not had an opportunity of calling their Committees together. A gentleman representing Leeds would, he believed, tell the Committee this. But, speaking for his own clients, they were not in a position to go on at once; and he took it that the Alkali Manufacturers would not object to a short postponement.

The CHAIRMAN: What do you suggest?

Mr. BALFOUR BROWNE: I suggest certainly not before a fortnight.

The CHAIRMAN said the difficulty was that the Committee had been brought together, and all parties, he took it, were anxious to dispose of the matter with the least possible delay. Further, he must point out that the appointment of the Committee was known as long ago as last July.

Mr. BALFOUR BROWNE agreed, but remarked that the date of the sittings was not known.

The CHAIRMAN admitted that this was so, but thought it must have been assumed that the sittings would be as soon as possible after the Committee was formed.

Mr. BALFOUR BROWNE said that, with regard to legislation, even if the Committee's report were made many months hence, it would do for the next session of Parliament; so that the parties concerned had not anticipated that there would be an immediate inquiry.

The CHAIRMAN remarked that the Committee had called a meeting for next Tuesday. Did not the parties think they could be ready by then? After all, it was no new question.

Mr. BALFOUR BROWNE said he thought Mr. Fitzgerald would find next week very inconvenient, and would probably support his application for a fortnight's adjournment.

The CHAIRMAN reminded Mr. Balfour Browne that, of course, Mr. Fitzgerald would open, and would probably take several days with his opening speech and calling witnesses.

Mr. PRITCHARD said that, on behalf of the Association of Municipal Corporations, it would be a very great convenience to them if it were possible for the Committee not to sit until (say) that day fortnight. They had not had an opportunity of considering the matter; and, of course, it was necessary to refer to the committees of the different corporations in regard to it.

Mr. FITZGERALD remarked that the Alkali Manufacturers, who would be the parties to commence, did not wish to force the other parties on without giving them a reasonable time to be ready. But what he would most respectfully ask was that, once the inquiry was commenced, it should go on and be finished without adjournments. Under these circumstances, he did not think the Alkali Manufacturers would desire to resist the application of his friends that the proceedings should be adjourned for a fortnight. But they should then proceed *de die in diem* on the three days of the week that had been mentioned by the Chairman, until the inquiry was finished. In order to relieve the apprehensions of the Committee as far as the Alkali Manufacturers were concerned, he would point out that their case was a short one. He should certainly not take a long time in opening, because, though the points involved were important, they were in a very narrow compass; and he hoped that the witnesses he would call would not take more than two days. He could not conceive, himself, more than six days—*i.e.*, two weeks—being taken up by the whole of the inquiry; but, of course, he could not speak for the other side. Next week was really very inconvenient, for the reason that an important Local Government Board inquiry was fixed at Leeds more than a month ago. It would not last beyond two days; but he was himself obliged to be there representing the West Riding County Council. Mr. Honoratus Lloyd, K.C., who was also appearing before the Committee on behalf of the Alkali Manufacturers, was representing the Leeds Corporation at the Local Government Board inquiry; and there might be some other Counsel in the present case who were engaged at Leeds. Under these circumstances, he would support the application to adjourn for a fortnight, and then go on and finish the inquiry. It seemed that this would suit the convenience of all parties, and also that of Counsel.

The CHAIRMAN pointed out that he could say at once that the Committee would sit continuously once they started, for at least three days a week.

Mr. ROBERTS asked Mr. Balfour Browne how long he thought the case would take.

Mr. BALFOUR BROWNE replied that he did not think it should be very long. He would have a considerable number of witnesses, and would probably take about three days altogether.

The CHAIRMAN said the Committee quite understood the reasons given by Counsel—and would meet that day fortnight—Nov. 26—at 11 a.m.

Mr. BALFOUR BROWNE inquired whether it was the intention of the Committee to have the proceedings printed and delivered every morning, as in the case of a Private Bill.

The CHAIRMAN said he understood that the proceedings would be printed by the House, and could be purchased daily.

The Committee then adjourned until the 26th inst.

East Surrey Water Order.—The Water Orders Confirmation Bill [Lords], containing the East Surrey Water Order, which was referred to a Select Committee of the House of Commons about three weeks ago, was reported last Tuesday—Provisional Orders confirmed. The report was ordered to lie upon the Table. Subsequently, Mr. Malcolm, the Member for Croydon, gave notice that when the Bill came before the House for consideration he would move the deletion of the East Surrey Order.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE—DIVISIONAL COURT.

Thursday, Nov. 14.

(*Before Justices* CHANNELL *and* AVORY.)

Drakes Limited v. Tottenham and Edmonton Gas Company.

This was a motion on behalf of the plaintiffs to set aside the award of an Arbitrator.

Mr. COMPSTON, K.C., and Mr. WHATELY represented the appellants; Mr. HOLMAN GREGORY, K.C., and Mr. GUTTERIDGE appeared for the respondents.

Mr. COMPSTON said this was an application by Messrs. Drakes Limited, of Halifax, to set aside an award made by Mr. Goulden, in the matter of an arbitration, upon the ground that the Arbitrator had received evidence affecting vital interests in the case, which was communicated in writing to the Arbitrator, but never shown to Drakes; so that they had no opportunity of being heard on the matters. The respondents raised the question whether the submission to arbitration was a submission within the meaning of the Arbitration Act; but the terms of the reference made it perfectly plain that it was a proper submission. The suggestion apparently was that it was not a legal submission. It appeared that, by an agreement made in February, 1908, the contractors agreed to execute or complete the work required for making a retort-setting for coal-gas manufacture; the contract price being £9900 in satisfaction of all claims. Then the submission went on to say that the contractors alleged that they had suffered loss towards which the Company should contribute. The Company, although denying any liability, stated that they were prepared to contribute, and it was agreed that the question of whether it was fair that the Company should pay anything, and, if so, what amount, towards the loss incurred by the contractors, should be referred to the decision of Mr. Goulden, the Chief Engineer of the Gaslight and Coke Company—his award to be final and binding, and that the agreement was to be deemed a submission to arbitration within the meaning of the Act.

Mr. Justice CHANNELL said it also stated that the Arbitrator was to hear evidence.

Mr. COMPSTON said that was so, and his submission was, that it was not now open to the parties to say that there had not been a submission.

Mr. Justice CHANNELL asked what the other side had to say upon the point.

Mr. GUTTERIDGE said the point was not taken as a preliminary one, but as a substantial one, and would be dealt with later on.

Mr. COMPSTON said the award was dated Feb. 22, 1912; and after stating that the subject of the reference was a request by the contractors that the Gas Company should make some contribution in respect of the loss alleged to have been sustained in the setting of the

retorts, it proceeded to say that the contract was for twelve bench settings, and, after being put to work, in consequence of open cracks developing, certain repairs and renewals were decided upon which had to be carried out to the satisfaction of the Engineer, and should be inspected by the Arbitrator, who was to decide as to the efficiency of the repairs. The repairs were carried out; and the following September, after five months' work, the retorts had become so misshapen that it was clear something was seriously wrong. Upon an inspection being made, it was found that the settings were imperfect; and it was decided that a complete re-setting was necessary. This was done by the contractors and finished in the early part of 1910. The loss to the contractors amounted to £4159, made up of three sums of £443, £1305, and £2411 respectively. The Arbitrator ruled the £443 out of consideration, as the contractors were not called upon in connection with the original installation to do extra work. As to the £1305, he considered the contractors had a good claim for sympathetic consideration by the Company, as the work was carried out under the supervision of their Engineer, and was well performed. The failure of the settings was not due to any error of design, but to the use of improper bricks; and the Arbitrator suggested that the contractors should be allowed half the amount which they claimed. Up to this point of the award, the appellants made no objection whatever; but they did object to what had been done in regard to the item of £2411 expended in the re-setting of the bench after the settings had failed between that time and the spring of the same year, when they were partially renewed. The Arbitrator found that the same condition of responsibility did not hold good—that Drakes undertook the fullest responsibility for putting the settings in an efficient condition, and that the Engineer assumed no responsibility; that the failure was due to the use of Stourbridge bricks; and of the entire claim of £4159 he awarded only £652 10s. He then went on to state that he had been informed by Mr. Broadberry, the Engineer of the Gas Company, that the Company suffered serious losses owing to the plant being out of condition during the latter part of 1908, the earlier part of 1909, up to and including part of May, and again in the latter part of 1909 and the early spring of 1910. Mr. Broadberry had satisfied him that the Company's additional cost of conducting the manufacture, arising out of the manner in which the work was carried to the point of producing efficient settings, amounted to a sum in excess of the £652 10s.; and he did not therefore consider, in respect of Drakes' loss in connection with the carrying out of the contract, the Company could be fairly called upon to contribute any sum in addition to the £9900—the amount of the contract price. The question was, had Drakes assumed responsibility for the reconstruction of the setting of the retorts upon the same lines as had previously failed; and, secondly, had the Company sustained any loss which ought to be paid for by the contractors? He submitted that written statements were made by Mr. Broadberry which were never shown to them, and about which they had no opportunity of cross-examining him; and the Arbitrator had held that the Gas Company were entitled to set off sums in respect of two periods as to which he stated the contractors were under no responsibility.

Mr. Justice AVORY asked whether witnesses were called before the Arbitrator?

Mr. COMPSTON said no; it was agreed that written statements alone should be submitted. The statement on behalf of the contractors was sent, and, he supposed, was submitted to the Company; but the contractors never saw that sent by the Company. After calling attention in detail to the correspondence which had passed between the parties, Counsel submitted that the award could not possibly stand, and that it should be set aside.

Mr. GREGORY said he intended chiefly to rely upon the fact that the applicants acquiesced in the course taken—in fact, they themselves suggested it. The applicants claimed some legal right in respect of a matter as to which all legal right had been abandoned; and they could not now come and say they were entitled to enforce a right that they possessed.

Mr. Justice CHANNELL said the agreement of reference ought to have been carried out—namely, for Mr. Goulden to say what was right and proper to be done under the circumstances.

Mr. GREGORY said he did not desire to emphasize the point, but merely to mention and pass away from it. With regard to the peculiar position of Mr. Goulden, this gentleman had been the expert who had watched the making and failure of these particular retorts, and was therefore in a position to say whether the claim made by either side was right or wrong, though he could not go into actual figures.

Mr. Justice CHANNELL said Mr. Goulden did not know Mr. Drake had admitted liability; but Mr. Broadberry informed him of it.

Mr. GREGORY said it was merely admitted that he was liable for what had happened, and that there was no legal claim upon the Gas Company; that was all the letter meant.

Mr. Justice CHANNELL said the point that Mr. Goulden had found against Drakes was that the failure of the re-setting was entirely the fault of the contractors.

Mr. GREGORY said the position with regard to the first setting was that Mr. Broadberry had suggested they should have Stourbridge bricks; but Drakes used them the second time, knowing that on the first occasion they had failed. There was also the point whether this was to be treated as a formal arbitration—whether Mr. Goulden was not being treated by both parties as an expert.

Mr. Justice CHANNELL said the real point was whether Mr. Goulden had received a controversial statement from one side without communicating it to the other.

Mr. Justice AVORY said it seemed a question whether the Arbitrator received evidence on a question of fact which was not communicated to the other side, because in the award he said: "I cannot find that in doing so any direction or responsibility as to the method to be employed was in any way approved by the Engineer."

Mr. GREGORY said this applied merely to the Stourbridge bricks. If it was not an arbitration, the Court had no power to deal with it.

Mr. Justice CHANNELL pointed out there was an express statement that it was to be treated as a submission to arbitration.

Mr. GREGORY said that what the Court had to consider were the actual words in the statement, and not the submission.

Mr. Justice CHANNELL said it was a reference to the personal opinion of Mr. Goulden on his ascertaining the facts in controversy; but in doing this he must do it in a proper manner, and he was not to receive a statement from one side without communicating it to the other.

Mr. GREGORY said the strong distinction between an arbitration and a valuation was this—that if it was an arbitration it had to be conducted in a *quasi*-judicial manner; but where it was merely an expression of opinion by the expert, he was not called upon to deal with it in a judicial manner, and his position could not be questioned by the Court. Dealing with the main question, he pointed out that the contractors had assented to what was done; and it was only when they found the award was against them that they objected. This was not what might be called acting fairly. In the first letter, Mr. Drake asked for a cheque for £1300, which would "cover all claims against the Company," and then asked for some consideration towards meeting them. This letter was answered by Mr. Broadberry, who said: "I now understand you have abandoned all legal claims against the Company, and I send you the cheque in full satisfaction of all claims under the contract" Then he suggested that the question should be referred to Mr. Goulden as a matter of grace, to see what sum should be paid. The contractors knew there was going to be a claim made by the Company in respect of loss; and the allegation was now that the Arbitrator had been guilty of some impropriety.

Mr. Justice CHANNELL said he would rather put it as an error of judgment.

Mr. GREGORY said before the appellants sent in their claim, they knew the Company were saying the Arbitrator must consider what they had lost in consequence of the contractors' conduct. Then the parties agreed that they should not appear by solicitor, but that written statements should be sent; and they were not now entitled to turn round.

Mr. Justice CHANNELL said that if each side was to send in a written statement, it did not mean that one side was not to see what had been sent in by the other.

Mr. GREGORY said the appellants sent in their statement; but they did not ask the Arbitrator to send a copy to the Company, and, in fact, a copy was not sent. By their conduct it was quite clear that they acquiesced in what was done; and they were now estopped from raising the point. Messrs. Drakes knew that Mr. Broadberry was going to send in his statement, and they wrote and expressed their surprise that the statement had not reached the Arbitrator: but they did not go on to say: "We must see a copy of it," or: "Please do not act upon it until we have seen it." Both statements went in to the Arbitrator, who then asked for further information from Drakes, which was supplied.

Mr. Justice CHANNELL: If Mr. Goulden got the statement from Mr. Broadberry, why did he not say that he had said so and so; do you agree with it?

Mr. GREGORY said what was sauce for the goose was sauce for the gander.

Mr. Justice AVORY pointed out that the letter of Nov. 28 from Mr. Goulden to Messrs. Drakes contained a number of queries, and asked whether there was any answer to it.

Mr. GREGORY said he had not seen any answer.

Mr. Justice AVORY said it might help the Company out of the difficulty if the Arbitrator had asked each party the same question though behind the other's back, and received an answer from each. If this was the case, they might both be in the same position, and neither could complain.

Mr. GREGORY said there must have been an answer, because on the next day Mr. Goulden acknowledged the receipt of the letter.

Mr. Justice CHANNELL suggested that the matter should go back to the Arbitrator for decision.

Mr. GREGORY said he was quite prepared to accede to this suggestion, if the costs of the appeal were made to abide the result.

Mr. WHATELY said he did not agree to the matter going back. He wished the award set aside, as he believed they had a very good case in respect of the two large items as to which the Arbitrator had found that the contractors had fulfilled the original contract properly.

Mr. Justice CHANNELL asked whether it was likely anybody would listen to this after an award had been withdrawn. What had been done was no doubt due to inadvertence, though possibly it was a legal wrong.

Mr. WHATELY said his clients thought it would be no use going back to the same Arbitrator, who had been guilty of legal misconduct in taking evidence behind their backs.

Mr. Justice AVORY thought the correct way of putting the matter was this: That the Arbitrator had not done wrong if both parties had invited him to do it in this way.

Mr. WHATELY agreed that it might be so if both parties had asked him; but his clients certainly had not. He was quite willing that the matter should go before another Arbitrator to be agreed upon or to be named by the President of the Gas Institution.

In giving judgment,

Mr. Justice CHANNELL said he was of opinion that the motion must be refused. The application was to set aside an award; and upon this the Court had jurisdiction to send the matter back to the Arbitrator. They had offered to do so; but the applicants declined to accept it. The reference to Mr. Goulden to say what was fair between the parties was one which had to be conducted judicially; he could not take statements from one party behind the back of the other. It was agreed that each side should send in a written statement of the case. There was nothing, however, to the effect that the statement should be communicated to the other side; and so long as the statements were not of a controversial nature, there was no reason why they should be communicated to the other side. It appeared that a statement was sent in by Mr. Broadberry containing controversial matter; and it would have been right if the substance of it, if not the words, had been communicated to Drakes before the Arbitrator acted upon it. However, he did ask in general terms for an answer upon the same matter—not stating what had been said; and the question did not appear to have been answered. This was not enough to dispense with the necessity of telling Drakes that the statement had been made by Mr. Broadberry. He thought there was legal misconduct which possibly might have justified the Court in setting aside the award; but it was entirely a

matter of discretion whether it should be set aside or sent back. It was not the practice of the Court to set aside an award in a matter of this kind, but to send it back. Mr. Goulden was the only person who could arbitrate upon the matter, as there was not a general submission to arbitration. Under all the circumstances, he thought the proper thing to do was to refuse the motion.

Mr. Justice AVORY said he agreed that the application should be dismissed. If it had been left to him to decide whether the award should be remitted to the Arbitrator, he should have hesitated to differ from his learned brother; but he would have required further time before he could have assented, as it appeared from the correspondence which passed between Nov. 28, 1911, and Feb. 28, 1912, there was acquiescence on the part of Messrs. Drakes to information being furnished to the Arbitrator on the very question in dispute, by means of statements made by either party behind the back of the other. The letter of Nov. 28 asked Messrs. Drakes whether the re-setting work was done under the supervision and control of the Engineer of the Company. Messrs. Drakes undoubtedly replied to this letter, though there was no letter showing that they actually replied to the questions asked. But when one looked at the letter of the Arbitrator of Dec. 28, after he received Messrs. Drakes' reply, this appeared: "I take it I may assume that the condition governing the original setting also applies to the re-setting of the retorts on the second occasion." Therefore, it was clear he had had an answer, or was assuming that this was the true position. In reply to this letter, the information now complained of was supplied by the Gas Company. For this reason, he should have doubted whether the applicants could have complained of the statements contained in the letter; but it was not necessary to give any opinion about this. He agreed there was no ground for setting aside the award; and as the applicants declined to agree to the award being sent back, the motion must be refused.

Mr. WHATELY said he did not know whether leave to appeal was necessary; but, if so, he asked for such leave.

Mr. Justice CHANNELL said he did not think leave was necessary; but, if it was, the Court did not feel disposed to grant it.

HEAVY TRAFFIC AND BROKEN GAS-PIPES.

A Question of Liability for Damage.

At the Oldham County Court last Thursday, his Honour Judge Bradbury had before him an action brought by the Oldham Corporation against Mr. Norman E. Box, haulage contractor, of Blucher Street, Manchester, to recover £2 9s. 3d., the cost of repairs to a gas-pipe and to the surface of a roadway, for which, as was contended, he was liable.

Mr. GARSIDE (Deputy Town Clerk) said the damage was done by a traction-engine belonging to the defendant having made use of the highway. On the 29th of August last, the engine was used in the street in question for about two hours. It was noticed late in the afternoon that there was an escape of gas; and an employee of the Corporation went to the spot and found that the paving had gone down and that the 3-inch gas-pipe was broken. The Corporation claimed to recover the cost of the repair under section 23 of the Highways and Locomotives Act, 1878, which was as follows:

> Where by a certificate of their surveyor it appears to the authority which is liable or has undertaken to repair any highway, whether a main road or not, that, having regard to the average expense of repairing highways in the neighbourhood, extraordinary expenses have been incurred by such authority in repairing such highway by reason of the damage caused by excessive weight passing along the same or extraordinary traffic thereon, such authority may recover in a summary manner, from person by whose order such weight or traffic has been conducted, the amount of such expenses as may be proved.

The weight of the engine was 13 tons 18 cwt., and it was drawing out of some works an old boiler of which he did not know the weight.

Mr. FRIPP, who appeared for defendant, said it was about 6 tons.

His HONOUR asked what was the position of a person using the highway.

Mr. GARSIDE said everyone was entitled to use the highway; but this was a case of extraordinary traffic, and under the clause quoted the Corporation were entitled to recover the cost of repair made necessary thereby.

His HONOUR pointed out that, under the clause, a certificate of the Surveyor was necessary, and he asked Mr. Garside if he had one.

Mr. GARSIDE said he had not; and he gave as the reason that the matter had all along been in the hands of the Gas Department.

Mr. FRIPP said he admitted that the total weight of the engine and boiler was between 18 and 20 tons.

Mr. GARSIDE said the damage to the surface was covered by the Highways and Locomotives Act, and the damage to the pipes came under section 158 and others of the Local Act of 1865.

His HONOUR: Is there anything which gives the Corporation a right to recover for damage to their pipes through traffic over the road surface?

Mr. GARSIDE: There is no special provision.

Then what do you rely upon? It is a lawful user of the highway, subject to the proviso you pointed out in the Highways Act.—We have no special statutory provision. It is only evidence of negligence.

Negligence! What duty is there a breach of? Do you say it is illegal to take a boiler along a highway?—No.

They are exercising a legal right. How do you say it is negligence? What is their duty?—It is their duty to have regard to the fact that mains are laid along the highway.

I do not know. It may be the duty of the Corporation to see that their pipes are laid at a sufficient depth. Unless you can show me some statutory provision, I cannot see any case with regard to the pipes.—I am afraid I cannot. The driver can be made liable.

I very much doubt if you could recover against the driver if he was told by his master to drive along a certain road.

Mr. GARSIDE proceeded to quote the clause bearing upon the matter in the Act of 1847, incorporated in the Act of 1865.

His HONOUR: You are not suing the driver in this case, and it amounts to this, that there is no statutory provision enabling you to recover for the damage to the pipes. According to the law, the traction-engine has a right to go along the road. They broke your pipe. You say that is illegal. I do not know. What duty do they owe to you?

Mr. GARSIDE: They must have regard to the pipes.

Why? What is your authority? Where do you get the "must" from? It is you that must have regard to the traffic.

Mr. GARSIDE said he could not take the point any farther.

His HONOUR: This is a novel case, and I want some assistance; and if you ask me for a judgment, you must give me some ground for it. It may be that this modern traffic is a new thing not contemplated in the Acts, and it may be that gas companies may have to seek some remedy. But at present I must rule there is no case as regards the breaking of the pipe. With regard to the surface damage, there comes the question whether there is excessive weight—extraordinary traffic. We know what the weight is. Do you say 18 tons is excessive?

Mr. GARSIDE: Yes; we say that 18 or 19 tons is excessive.

How do you judge? What is the criterion—your standard?—It is very difficult to say.

But I look to you for assistance in this matter. What is your standard?—About 8 or 10 tons.

Mr. FRIPP: We have obtained a licence from the Corporation for 13 tons 18 cwt. [The licence was produced.]

His HONOUR: It is a permit to use the machine within the borough; and you would not say that six tons is too much load for an engine weighing 13 tons 18 cwt. to draw?

Mr. GARSIDE: No.

Mr. FRIPP said that in July the defendant was engaged by the Corporation to carry a load of 20 tons.

His HONOUR said it appeared to him that an action could not lie in the case. He thought the licence put an end to the question. It would be an extraordinary thing that a man should be mulcted in damage for using the highway when the Local Authority said he had a right to use it. Judgment would be for the defendant on both grounds—with regard to the pipe and with regard to the surface; and as the case was one of considerable public importance, costs would be allowed on the higher scale.

Damages for Personal Injuries.

Last Friday, John Thomas Sewell, a hawker of coke, sued the Gaslight and Coke Company, before Mr. Justice Banks and a Common Jury, in the King's Bench Division of the High Court of Justice, to recover damages for personal injuries sustained, as he alleged, owing to the negligence of the defendants. The latter denied negligence, and pleaded contributory negligence on the part of plaintiff. On the 12th of January last, the plaintiff went with his donkey and barrow to get a load of coke from the defendants' premises. As he was driving away, his barrow was upset in trying to cross on the Company's works, a tramline, a rail of which projected above the roadway. Plaintiff was thrown, and injured a leg which had previously been hurt; and since January he had been attending hospital. After hearing all the evidence, the Jury returned a verdict for the plaintiff, with £200 damages. Judgment was given accordingly, with costs.

Affairs of the Mid-Oxfordshire Gas Company, Limited.

On several occasions recently the affairs of this Company have been under consideration in the Companies Winding-Up Court; and on Friday last, a question as to the priority in which the debenture-holders rank was decided by Mr. Justice Neville. The question at issue was raised by the application of a general debenture-holder for an order that the certificate of the Registrar dealing with the rights of the debenture-holders might be varied by striking out his finding that the special series of debentures therein mentioned (being the special debentures secured on the various gas-works of the Company) rank *pari passu* as regards the assets of the Company not specifically charged by the indentures therein mentioned and the assets comprised in the floating charges to which the holders of such debentures are entitled, and in priority to the remaining debenture and debenture stock issued by the Company, which remaining debentures and debenture stock rank *pari passu*, and substituting therefor the finding that all the debentures, including the special series, rank *pari passu* as regards the assets of the Company not specifically charged by the special series. The Counsel for the applicant pointed out that the question at issue was, shortly, whether those of the special debenture-holders who had a deficit in respect of their own first mortgages were alone entitled to participate in the surplus money in Court derived from the sale of the Chipping Norton, Bicester, and Woodstock Gas-Works, after payment of the first mortgage on these several works, or whether they had to participate in the surplus together with the general debenture-holders. After considerable argument, his Lordship held that the Registrar was right in his finding, and that the special debenture-holders alone were entitled to participate in the assets of the Company not specifically charged by the indentures securing the special debentures.

Scunthorpe District Gas Supply.—At the meeting of the Scunthorpe Urban District Council last Wednesday, the Frodingham District Council intimated that they were promoting a Bill to obtain powers to build gas-works of their own, and to include Ashby in the area of supply; also that they were giving notice to purchase all the mains and works in the Frodingham area now belonging to the Scunthorpe Council. With reference to Scunthorpe's application to the Local Government Board for powers to supply Ashby with gas (Ashby having agreed to take it), the Board stated that a local inquiry would be held. In the event of further extension of the Scunthorpe Gas-Works, and having regard to the unsuitability of the present site and the development of the town, negotiations have been entered into with Lord St. Oswald's agent for the purchase of 12 acres of land in the Wheatlands, Scunthorpe.

MISCELLANEOUS NEWS.

CONTINENTAL UNION GAS COMPANY.

Annual Report and Accounts—Settlement of the Messina Trouble.

At the Ordinary General Meeting of the above-named Company on the 3rd prox., the Directors will submit the accounts for the financial year ended the 30th of June last. They show that the profits amounted to £55,003; and adding the balance of £11,059 brought forward, there was produced a total of £66,062. Deducting £10,000 in respect of the Messina amortization, there is left an available profit of £56,062. Interim dividends of 3⅛ and 2 per cent., amounting to £22,591, were paid in July last; and the Directors propose to pay dividends at the same rates for the second half of the year. These together absorb £45,183, and leave £10,879 to be carried forward. In their report, the Directors remind the proprietors that at the last three annual meetings particulars were given by the Chairman respecting the negotiations with the authorities at Messina for the payment of the town's indebtedness to the Company, and the settlement of pending questions. Negotiations have been carried on continuously since the last meeting; but, notwithstanding the fact that in May last the Chairman and Mr. A. F. Phillips, one of the Directors, had an interview with the Government authorities in Rome, and came to an agreement with them, it was not till the 26th of October that the settlement was finally signed. The Directors express their pleasure in reporting that the agreement has been definitely approved, and that there is every hope that the payment of the amount agreed upon (about £27,300 sterling) in settlement of the debt will be paid before the end of the present month. Besides receiving the above-named amount, the Company retain possession of their private property, are freed from all obligations under the unexpired contract respecting the supply of gas, and are allowed to withdraw from Messina. The Directors consider the arrangement satisfactory; and they trust it will meet with the approval of the proprietors.

SOUTHAMPTON GAS COMPANY.

The Half-Yearly General Meeting of this Company was held at the Offices in Southampton a few days ago—Captain A. J. Corse-Scott, J.P., in the chair.

The Secretary (Mr. J. R. H. Jacobs) read the notice convening the meeting; and the report of the Directors (see *ante*, p. 374) was presented.

The Chairman, in moving the adoption of the report, expressed his pleasure at meeting the proprietors, as once again, as they would have seen by the statement of accounts, the Company had done extremely well in the half year under review. The net profit earned would allow of the payment of the maximum dividends, and also leave £981 to be carried forward—making, with that brought from the previous half year, an undivided profit of £2000. In addition to the ordinary revenue charges, £2585 had been allowed for depreciation; thus reducing the actual capital charges for the half year from £2833 to £247. The great coal strike in the early part of the year was anticipated by the Directors; and during the latter part of 1911 provision was made for it by storing a large quantity of coal. This proved a wise policy, as notwithstanding the fact that no coal was received for upwards of two months, the Company were enabled to meet the very heavy demands made upon them. New contracts for coal, &c., had been entered into at enhanced prices, but it was hoped that the price of gas would not be raised. Notwithstanding the excellent progress the Company made last year, the Directors were pleased to say the sale of gas was still increasing. The show-rooms, opened in October, 1911, had fully justified their existence. Consumers had been greatly interested in the large and varied display of gas appliances on view; and the business done accounted greatly for the increase in the sale of gas. A lady cookery expert had been employed, who personally visited consumers to give directions for getting the best service from gas used in cookers; and she was also engaged in giving cookery demonstrations in the lecture-room. The services of the Company's experts for advice relative to the equipment of premises with gas appliances, or the improvement of existing lighting, heating, cooking, or power arrangements, had been largely sought by consumers. In order to secure a better supply of gas to consumers in Redbridge, Totton, and Eling, a gasholder had been erected at Redbridge; and it would be brought into use very shortly. As the present retort-houses did not offer a sufficient reserve, the Directors had recently entered into a contract for the erection of a complete retort-house, fully equipped with all modern improvements; and this would be ready for use in October, 1913. The Chairman quoted figures showing the growth in the consumption in the Company's district during the past three years. The increase in the sale of gas had been 64 million cubic feet; in consumers, 3800; in cookers, fires, and radiators, 3380; in outside lamps, 591; in geysers, 141; and in consumers on maintenance, 1763. This he considered very satisfactory. In conclusion, he said the Directors desired to assure the stockholders that, notwithstanding the success of the Company in the past, they felt that the future of gas would be brighter than ever.

Mr. J. C. Moberly, in seconding the motion, remarked that it was exceedingly satisfactory to find that in one district in the town, where they had to compete very extensively with the electric light, there had been a decided increase in the sale of gas. This was very pleasing, especially because the sale of gas was at one time going down there, whereas now it was going ahead.

The report was adopted, and the maximum dividends declared.

A cordial vote of thanks having been passed to the Directors, and acknowledged by the Chairman,

Dr. R. Bencraft said it was no use having good Directors unless they had a good and efficient staff; and in this respect he did not think any company was better served than theirs. They were very fortunate in having men like Mr. Durkin as the Resident Engineer and Manager, and Mr. Jacobs as the Secretary; and he moved a vote of thanks to them and the staff generally.

Mr. E. H. Rose seconded the motion, and it was carried.

Mr. Jacobs, in returning thanks, said he was pleased to state that he had a staff who worked very loyally, and did their best for the interests of the Company.

Mr. Durkin also returned thanks on behalf of his department at the works.

Thanks having been accorded to the Chairman for presiding, the meeting terminated.

COST OF PUBLIC LIGHTING AT WHITBY.

Adverse Comparisons by the District Auditor.

At the last monthly meeting of the Whitby Urban District Council, the members had before them the report of the District Auditor (Mr. F. Murrey Wheatley) for the year ended the 31st of March, in the course of which he called attention to the high cost of the public lighting of the town. He stated that the total receipts on revenue account, which included £12,276 from the general district rates, at 5s. 4d. in the pound, amounted to £18,495; while the expenditure, of which £6290 represented the charge for repayment and interests in respect of borrowed money, and no less than £1826 for the public lighting, aggregated £17,651. The total indebtedness of the Council, at the close of the financial year, came to £85,871—an increase of £7394 since March 31, 1911. Among the trading concerns of the Council showing deficiencies was the electric light undertaking—the amount being £1348 16s. 4½d., or equal to 7d. in the pound; while the cost of public lighting necessitated a rate of 9½d. in the pound. As the latter item of expenditure seemed to the Auditor to be "abnormally high," he drew special attention to it, and compared it with Saltburn and Redcar, where the cost for the year 1911-12 was 5d. and 3·1d. respectively, and with several more distant places, where the rates range from 3·2d. to 5·3d.

When the report had been read by the Clerk, Mr. Cook said he thought the Auditor was a little off the mark in pointing out Redcar and Saltburn as comparable with Whitby. These places had no yards, and nothing but a few straight streets, which were easily lighted. They could light Whitby at half the present outlay if they had only a few straight streets. At the same time, he admitted that the cost of public lighting was considerably more than it should be—he was not going to minimize this view for one moment. The Chairman (Mr. T. H. Woodwark) said he thought the best thing would be to refer the report to the Finance Committee for consideration. Undoubtedly, the Auditor had picked out an item of very heavy expense on the part of the Council. Many of the members thought the charge for public lighting was a very heavy one; and they were confirmed in this opinion by the great increase in the cost since the town was lighted by gas—not that electricity was dearer than gas, but the Council had put up many more lamps in various parts of the town. Mr. Rennison remarked that still they were not too well lighted. The Chairman said he was afraid that not many of the Council would agree to more money being spent. It was unanimously resolved to refer the report to the Finance Committee.

It may be mentioned that four years ago the Directors of the Gas Company offered to light the whole of the town with incandescent gas at a cost of £1065; but the offer was declined, for the reason that it would not be to the interest of the town or the Electricity Department to accept it.

BURTON GAS COMMITTEE AND STOVE AND LAMP HIRE

Opposition by Traders.

The Burton-upon-Trent Town Council had before them at their meeting on the 9th inst. a report of the Gas and Electricity Committee which contained a proposal that they should be authorized to let gas fires and lamps on hire. To this proposal objection had been made by certain tradesmen in the town, who presented a petition against it, on the ground that it would deprive them of their business. They thought, considering the extent to which local tradesmen were already suffering, every means should be adopted by the Council to help and not hinder them. If further developments in the Gas Department were considered necessary, they, as a body of tradesmen, felt they ought to participate therein.

Alderman Lowe, the Chairman of the Committee, in moving the adoption of the portion above referred to, pointed out that the more gas there was consumed, the better it would be for the Corporation. He said he was quite satisfied that the use of gas-fires in the town was in its infancy, and the proposal, if adopted, would be a source of considerable revenue. It would be in the interest of the Corporation and the consumer that it should be made easy for the latter to use apparatus which would help the sale of gas. They proposed to make a charge of 4s. a year for a small fire, which would repay in ten years the cost and the interest on the loan. Every large town was doing the same, and in Glasgow 40,000 gas-fires had been installed in the last seven months. The Committee were faced with a petition from 31 traders, because, no doubt, they considered the scheme would be detrimental to their interests. He, however, thought it would not be so. He was entirely opposed to municipal trading, unless it was in connection with a thing which the ordinary individual could not supply. If it was suggested that the gas-fitters of the town would hire-out from 5000 to 10,000 gas-fires, the Corporation would gladly stand aside; but during the last year only about 60 fires were installed by the 31 firms—a number which might possibly bring in about £25. The Committee, however, proposed that for every order a tradesman brought in they would pay him 2s. 6d., which would be more than 10 per cent. on the cost of the stove. Therefore, if there should be a great demand, the traders would stand a better chance of making more out of it than at present. Twelve orders a day would mean 30s.; and he thought their trade would be

greatly increased. He considered the Committee's offer was a fair one; and they wished to work entirely in sympathy with the tradesmen.

Mr. KING seconded the motion.

Alderman TRESISE, a member of the Committee, moved, as an amendment, that the portion of the report under consideration should be referred back. As the Chairman of the Committee was willing to discuss the matter with the parties interested, there was no reason why it should not be held over for a month.

Mr. BIRCH, in seconding the amendment, said that, though he did not think there was any desire on the part of the Committee to enter into unjust competition with the traders concerned, a considerable amount of feeling had been aroused; and for this reason he supported the reference of the matter back to the Committee.

Mr. HUTCHINSON asked whether the people who signed the petition knew the terms upon which the gas-fires were to be supplied. Did they understand that they were going to receive a commission of 2s. 6d. per stove? Perhaps Alderman Lowe would agree to the question being left over for a month.

Alderman LOWE said he did not think anything would be gained if they postponed it.

Mr. HUTCHINSON said he agreed with Alderman Lowe that the more gas they sold the more they would contribute to the rates; but this applied because the Corporation were the only manufacturers of gas. It did not apply, however, in the case of stoves, &c., and there were two questions he should like to ask the Chairman. First, were the local tradesmen able to supply the best appliances? If not, were they prepared to stock them? Secondly, if they were able to supply them, were they doing so at fair prices? If they were prepared to do the latter, then the question of selling a larger quantity of gas did not enter into the computation; for if the Committee interfered with local trade to the extent that tradesmen had to shut up their shops, they would be doing themselves far greater harm. At their sewerage farm they had a dairy; but they were not supplying municipal milk, because it would tend to injure private dairymen. Neither did he think the first business of a gas committee was to sell gas-fittings, but to supply gas of the best quality and at the lowest price. He suggested that if the Committee established a show-room, as had been mooted, it should be worked on the system that the space in it should not be occupied by the Gas Committee, but should be apportioned to tradesmen who dealt in these particular goods, at a certain rent.

After some further discussion,

Alderman LOWE replied, and contended that the scheme submitted by the Committee was in favour of the Corporation, the ratepayers, and the traders themselves. Answering a question by Mr. Hutchinson, he said the large majority of the traders were informed of the terms offered.

The amendment was then put, and carried by 22 votes to 7.

The subject dealt with above was referred to at the annual dinner of the Burton Chamber of Trade on Monday last week. Mr. Tarver, speaking for himself and the Gas Committee, said they did not wish to injure a single trader in the town. When the time came, the Committee would ask the co-operation of the traders; and he thought they would be able to convince them that the policy proposed would be not only for the town's good but for theirs also. Mr. Hill said the proposed municipal undertaking would, he believed, extend the traders' businesses; and, as time went on, they would see that the Council were watching their interests in every department.

HOVE CORPORATION AND ELECTRIC LIGHTING.

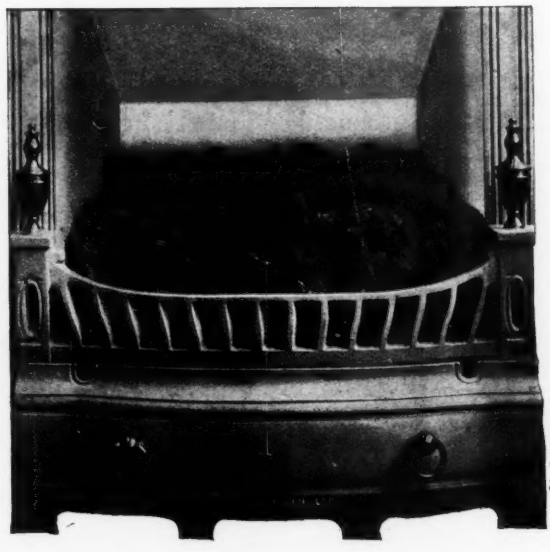
Company's Undertaking to be Purchased.

The Hove Corporation have for some weeks had under consideration the subject of purchasing the undertaking of the Hove Electric Lighting Company—a private concern, with a capital of about £170,000, established twenty years ago, under a Provisional Order which reserved to the Corporation the option of purchasing the business at the expiration of twenty-one years. After the subject had been discussed by the Council, it was deferred to allow the ratepayers to express their views upon it. This was done, and the result was an overwhelming majority against the purchase. Public opinion generally, however, had been sharply divided on the question; and it came up again at a special meeting of the Council held last Thursday.

A motion to give notice to the Electric Lighting Company was submitted by Alderman Nye, who, in supporting it, said that some twenty-one years ago the Council gave away the right to supply electric current to Hove. In the period which had elapsed since, the Company had built up a successful business, and had taken a great many thousands of pounds out of the pockets of the ratepayers. If their predecessors in office had shown a little speculative genius, all this money could have been saved to the ratepayers. What they had to do now was to exercise their right and stop the drain from the ratepayers' pockets, because it was an unfair drain; the average charge for current being 5½d. per unit, compared with 4d. in Brighton. By promoting a Bill for the purchase, they might probably get 40 years for the repayment of the loan. This would be an entirely different matter from getting a Bill through Parliament against the opposition of all kinds of vested interests. If they got forty years, it would cost £9750 per annum; thirty years, £11,200 per annum. The profits last year were £14,457; and if they were granted forty years for the repayment of the loan, there would be £5757 excess of revenue, or £4307 on a thirty years' repayment. He submitted, therefore, that after the first few years there would be a prospect of considerable sums to assist the rates.

In seconding the motion, Mr. Brown, said the electric light undertaking, which was a sound concern, paying a high rate of interest, could be acquired at what appeared to be a very moderate price. As to the public meeting, he wished to say, with all courtesy to those who attended it, that people having experience of public meetings knew that

VALUE FOR MONEY.



EXTRACT FROM YET ANOTHER TESTIMONIAL:—

"One of the outstanding features of the whole invention is the efficiency, and the deep sense of satisfaction of having *obtained value for money.*"

THE "ST. NICHOLAS" FIRE

Always gives satisfaction, and we are continually receiving spontaneous expressions of approval from delighted users.

R. & A. MAIN, LIMITED,

WORKS: Gothic Works, EDMONTON, N.; Gothic Ironworks, FALKIRK; and Gothic Works, BIRMINGHAM.

SHOW-ROOMS AND BRANCHES: 25, Princes Street, Oxford Circus, W.; 136, Renfield Street, GLASGOW; 56, Broad Street, BIRMINGHAM; 83, Old Market Street, BRISTOL; 13, Whitworth Street West, MANCHESTER; 8, Exchange Place, Donegall Street, BELFAST; 333, Queen Street, MELBOURNE; and 12, Cunningham Lane, Pitt Street, SYDNEY, N.S.W.

they seldom reflected the opinions or desires of a borough. Those members of the Council who were advocating the purchase, were endeavouring to secure rights which would be of the greatest importance to the borough.

Mr. Jago said he believed municipal trading to be bad, and therefore he opposed the purchase. Personally, he had the gravest doubts about the Council effecting any saving in working. He could not help thinking that the management of the concern under the Lighting Committee would be very different from that under a private Company, and that the Council would run a very real risk if they purchased the undertaking. The figures they had before them seemed like "a will-o'-the-wisp" and not likely to be realized.

After some discussion, a vote was taken, with the result that the motion was carried by a majority of one—17 for and 16 against. On the Mayor (Alderman Barnett Marks) declaring the motion carried, Mr. Jago said it was "a snap division," and he asked for another meeting to be called under circumstances that would ensure the vote being reversed. The remark was received with laughter.

Subsequently it was resolved to instruct the Town Clerk to give the necessary notices for a Bill to sanction the acquisition of the electric light undertaking.

RATES AND GAS, ELECTRICITY, AND WATER CHARGES.

Mr. James Carter's Annual Return.

We have received from Mr. James Carter, the Borough Treasurer of Preston, a copy of his tabulated statistics of rates levied, together with charges made for gas, electricity, and water, and profits and losses on municipal undertakings in a number of Provincial towns and a few Metropolitan Boroughs, for the year 1912-13. There are in all 132 places referred to, which is a large increase over the previous compilation, when the total number was 95. The populations range from 752,055 (Liverpool) down to 20,200 (King's Lynn).

The rateable values are highest in Westminster (£6,501,318), Liverpool (£4,798,516), Manchester (£4,656,699), Kensington (£2,424,233), and Leeds (£2,132,159), and lowest in King's Lynn (£86,397), Bacup (£87,380), Ilkeston (£88,333), Brighouse (£90,092), and Stafford (£94,235). The places most heavily rated are: Norwich, 10s. 7d. in the pound; West Ham, 10s. 6d.; Stoke (average), 10s. 6d.; Merthyr Tydfil, 10s. 2½d.; Lowestoft, 10s. 1d.; East Ham, 10s.; Ilkeston, 10s.; Colchester, 9s. 11d.; Hull, 9s. 7½d.; Batley, 9s. 7d.; Halifax, 9s. 6d.; Rotherham, 9s. 6d.; Sheffield, 9s. 2½d.; Leeds, 9s. 2d.; Wigan, 9s. 1d. Those which have the lightest rates are: Oxford, 4s. 8d. in the pound; Blackpool, 5s.; and Bournemouth, 5s.

Out of the rents of property and profits transferred from municipal undertakings, the rates are reduced in the following towns to the extent of 1s. or more in the pound: Dewsbury, 1s. 8½d.; Wallasey, 1s. 8½d.; Nottingham, 1s. 6½d.; Darlington, 1s. 6d.; Macclesfield, 1s. 6d.; Halifax, 1s. 5½d.; Stockport, 1s. 5d.; Stafford, 1s. 4½d.; Burnley, 1s. 4d.; Warrington, 1s. 4d.; Yarmouth, 1s. 4d. (electric light and tramways profits to reserve fund); Leicester, 1s. 3¾d. (water and electric light profits to reserve fund); Bolton, 1s. 2¾d. (water profits to reserve fund); Lancaster, 1s. 2¼d.; Carlisle, 1s. 2d.; Leeds, 1s. 1¼d.; Salford, 1s. 1d.; Rochdale, 1s. 0¾d.; Bury, 1s. 0½d.; and Mansfield 1s. At the other end of the scale, very small profits in aid of the rates were contributed by Bootle, 1d. in the pound; Cambridge, 1d.; Lowestoft, 1d. (electric light profits to reserve fund); Luton, 1d.; Newport (Mon.), 1d. (water profits to reserve fund); Swindon, 1d. (markets profits to reserve fund); West Bromwich, 1d.; Eastbourne, ¾d. (electric light and tramways profits to reserve fund); Hampstead, ¼d.; Kingston-upon-Thames, ½d.; Middlesbrough, ½d. (gas and electric light profits to reserve fund); Norwich, ¼d.; West Hartlepool, ¼d. (electric light profits to reserve fund); Eccles, ¼d.; Hove, ¼d.; Islington, ¼d.; and Leamington, ¼d.

Out of the total of 132 places included in the list, 23 made no profit for the reduction of the rates; and a separate table gives 55 instances in which the rates have been increased in consequence of losses on one or more undertakings which were probably in most instances intended to be remunerative. The largest individual losses chronicled arose in connection with docks at Bristol (£113,483) and Preston (£34,500) and water-works at Swansea (£29,668); while gas does not appear at all in this particular part of the return. Water losses at Bacup were responsible for an addition of 1s. 9½d. in the pound to the rates, and at Swansea of 1s. 2¾d. Electric light losses were incurred at Bath, Heywood, Ilkeston, Wakefield, and Worcester.

The table giving the charges for gas and water shows that the net price of gas for domestic lighting supply is highest at Lowestoft—3s. 7d. per 1000 cubic feet; while it is still lowest at Widnes, at 1s. 1d. per 1000 cubic feet—with an even lower rate for large consumers, engines, &c. In addition to Widnes, the following towns in Mr. Carter's list possess the advantage of a supply of gas for domestic lighting at 2s. or less per 1000 cubic feet: Sheffield, 1s. 3d.; Plymouth, 1s. 7d.; Sunderland, 1s. 9d.; Belfast, 1s. 9½d.; Keighley, 1s. 9¾d.; Bath, 1s. 10d.; Gloucester, 1s. 10d.; Gateshead, 1s. 10½d.; Newcastle, 1s. 10½d.; Bury, 1s. 11d.; Huddersfield, 1s. 11d.; Lancaster, 1s. 11d.; Luton, 1s. 11d.; Oldham, 1s. 11d.; Bradford, 1s. 11¾d.; Burnley, 1s. 11¾d.; Bristol, 2s.; Cheltenham, 2s.; Darlington, 2s.; Halifax, 2s.; Lincoln, 2s.; Rochdale, 2s.; St. Helens, 2s.; Tynemouth, 2s.; and Wallasey, 2s. The charge per B.T.U. for domestic supplies of electricity ranges from 6½d. at Bournemouth and 6d. at Hove and Oxford to 2¾d. at Bury, and 3d. at Ashton-under-Lyne, Belfast (flat-rate), Burnley (flat rate), Hyde, Ilkeston (flat rate), Southampton (flat rate), Stalybridge, and West Ham (flat rate). The charge for water for domestic purposes on a house of £15 rateable value is highest in Chatham—at 4s. 6d. in the pound. It is lowest in the following towns: Liverpool (within the city limits), 6¾d.; King's Lynn, 7d.; Worcester, 7d.; Worthing, 8d.; Brighton, 9d.; Hove, 9d.; Leamington, 9d.; Manchester (within the city limits), 9d.; Richmond (Surrey), 9d.; and

Bear this in Mind.

THE Steamless Radiator excels in ECONOMY any gas-steam radiator produced.—**TEST IT.**

The MAXIMUM gas consumption of the "Steamless," size for size, is the MINIMUM consumption of the gas-steam radiator.—**TEST IT.**

But, while burning less gas, the "Steamless" gives more heat, because its interior surfaces contribute their share.—**TEST IT.**

We hold large stocks of all standard lines, and CAN DESPATCH ON RECEIPT OF ORDER.—**TEST US.**

THE DAVIS GAS STOVE CO., LTD.,
Sales Department and London Showrooms: 59, Queen Victoria St., E.C.
(Phone: 742 Bank. Telegrams: "Degasco Cent, London.")

Southampton, 9d. The other places in which the charges are less than 1s. are: Bournemouth, Crewe, Gloucester, Oxford, Peterborough, Plymouth, Reading, Widnes, and York. At Preston (Mr. Carter's own town), the rates are 8s. 10d. in the pound; and they are relieved to the extent of 6¾d. by the profits transferred from reproductive undertakings. On the other hand, however, there is the deficiency on the docks and a loss on water which, it is stated, increase the rates by 1s. 8¾d. in the pound. The price of gas at Preston for domestic lighting is 2s. 8½d. per 1000 cubic feet; of electricity, 4½d. per unit; and of water, 1s. 6d. in the pound on £15 houses.

There is a table which shows in detail the amounts estimated for the current year to be transferred to the borough, district, or other fund from the individual reproductive undertakings.

GAS CLASSES AT WESTMINSTER TECHNICAL INSTITUTE

Additional Instruction for Gaslight and Coke Company's Apprentices.

Readers of the "JOURNAL" may remember that the apprentices of the Gaslight and Coke Company attend part-time day classes at the Westminster Technical Institute of the London County Council during the first two years of their apprenticeship, being allowed time off for this purpose, and afterwards attend evening classes at the Institute. The subjects taught are English, technical drawing, technical calculations, and science. The Education Committee of the Council have had under consideration a proposal from the Company that the boys should, at some later period of their apprenticeship, attend for six weeks during the day for their whole time, in order to receive instruction in joint-wiping; there being a gas-supply workshop available at the Institute. The Company are prepared to supply all material necessary for use in connection with this instruction, and to pay the Council £1 in respect of each boy who attends the six weeks' course. The Committee are advised that the instruction is of a special character, limited entirely to work in connection with gas-lighting fittings and with systems of hot-water apparatus where the means of heating is by gas, and, further, that this limited knowledge of joint-wiping is necessary for a fully-trained gas-fitter; and they think it is desirable that the Company's proposal should be adopted. In order to give the desired instruction to all the boys who have passed through their two years' training and to those who will enter upon the training during the period, a whole-time instructor of joint-wiping will be required for a period of three years. After this, unless the number of boys who enter upon the two years' training year by year increases from 24 a year, as is possible, the instructor will be required for half-time only. At the meeting of the Committee last Wednesday, they adopted a report embodying the foregoing particulars, and made arrangements accordingly. The salary of the instructor is estimated at £130 per annum.

BYE-PRODUCT COKE-OVENS IN THE UNITED STATES.

The "Chemical Trade Journal" recently contained the following particulars of the bye-product coke-ovens in the United States.

The most striking feature connected with the coke-making industry in the United States during the past year was the relative advance in the construction and operation of bye-product ovens; for whereas the total production of coke decreased 15 per cent. as compared with 1910, the output from bye-product ovens increased 10 per cent., and the increase in the number of this type of oven in operation was larger than in any year since it was introduced into the United States—the increase of 1904 over 1905 excepted. The production of coke in 1911 consisted of 27,703,644 tons of oven coke and of 7,847,845 tons of bye-product coke. In 1910, the production of oven coke was 34,570,076 tons, and of bye-product coke 7,138,734 tons. From these figures, it will be seen that the output of oven coke decreased by 6,866,432 tons, or 19·86 per cent., while that of bye-product coke increased by 709,111 tons, or 9·9 per cent. The number of ovens contributing to last year's production was 4320.

The value of the production of coke from the bye-product ovens in 1911 was £5,459,580—an average value of 14s. 6d. per ton; while the value of the coke produced in beehive ovens was £11,366,600, or an average of 8s. 6d. per ton. The difference of 6s. per ton in favour of the latter is, however, more than off-set by the cost of transportation from the ovens to the point of consumption. The total value of the bye-products obtained from the manufacture of coke in retort or bye-product ovens in 1911 was £2,006,793, or a little more than one-third of the total value of the coke produced, against £1,695,912 in 1910, and £1,614,990 in 1909. The above-mentioned value of the bye-products in 1911 was equal to the value at the mines of the coal used.

Below are shown the quantities and values of the products of the recovery ovens during the years 1910 (*a*) and 1911 (*b*):

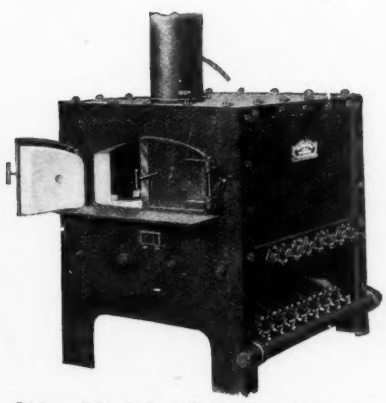
—	(*a*) Quantity.	(*a*) Value.	(*b*) Quantity.	(*b*) Value.
		Dols.		Dols.
Gas . . . . cub. ft.	27,692,858	3,017,908	33,274,861	3,781,218
Tar . . . . gails.	66,303,214	1,599,453	69,410,599	1,638,314
Ammonia, sulphate or reduced to equivalent, lbs.	70,247,543	1,841,062	72,920,056	1,943,761
Ammoniacal liquor, galls.	4,654,282	295,868	*4,660,596	*548,824
Anhydrous ammonia, lbs.	20,229,421	1,725,266	23,180,118	1,847,920
All other products . . .	..	..	..	273,915
Total value of products	..	8,479,557	..	10,033,961
Coke . . . short tons	7,138,734	24,793,016	7,847,845	27,297,897
Grand total	..	33,272,573	..	37,331,858

* Includes a considerable quantity of 100 per cent. ammoniacal liquor and of liquor sold on ammonia content, which accounts for the apparent marked increase in value.

Industrial Boom!

TRADE is booming! From the manufacturing centres comes the demand for efficiency and economy. Now, while the "shops" are at high pressure, is the psychological moment to introduce

GAS AS FUEL.



Richmond Single-Oven Natural-Draught Furnace.

We know by the enormous sale of our "A.B.C." and other Gasfires that Gas Engineers' interests are essentially centred upon the Gasfire business, but the fact should not be overlooked that an installation of

RICHMOND'S GAS FURNACES

may be worth more than a whole street of domestic consumers. Our Catalogue of Special Apparatus and Gas Furnaces will help you.

THE RICHMOND GAS STOVE & METER CO., LTD.,

Gas Furnace Specialists.

WARRINGTON. LONDON.

LIVERPOOL CORPORATION WATER SUPPLY.

Work for the Coming Year.

Last Tuesday, the Lord Mayor of Liverpool (Mr. J. S. Harmood-Banner, M.P.) presided at the opening of the proceedings of three of the Corporation Committees. In welcoming Colonel R. S. Porter, who had been re-elected Chairman of the Water Committee, he expressed the hope that under his direction the great water undertaking would do as well in the future as it had done in the past.

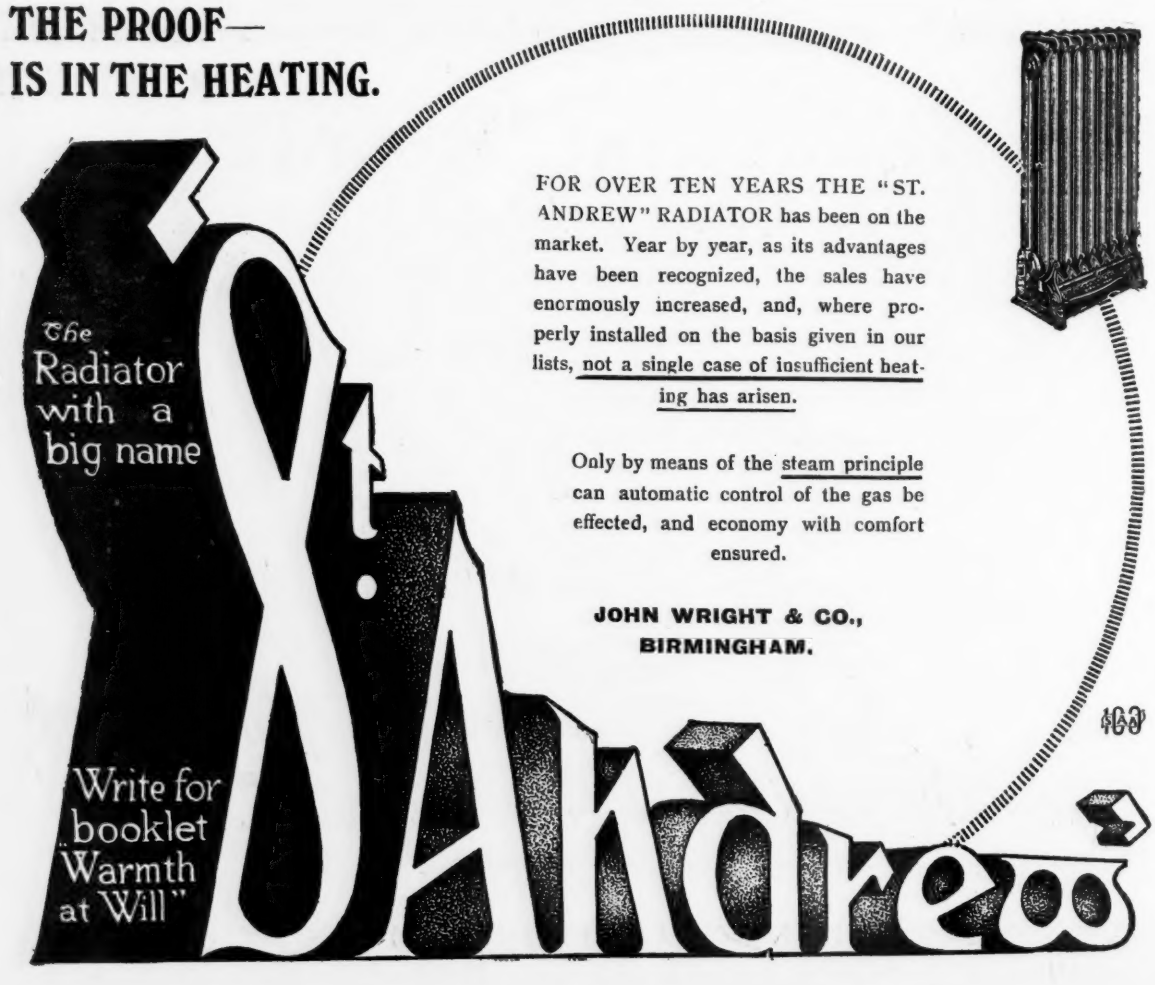
In thanking the members for their renewal of confidence in him, Colonel Porter congratulated the Lord Mayor on the dignity which had been bestowed upon him. The work before the Committee during the year was of importance; in fact, they had never entered upon a year more full of interest than that they were now commencing. It was expected that the new balancing reservoir at Malpas would be completed in the next six months. They had been covering a further portion of the goit at Brinscall, Rivington; and they understood it would be completed in about a month from now. Experiments were in hand, both at Rivington and Vyrnwy, with the view of effecting considerable improvements in the cleaning and operation of filter-beds, so as to produce greater efficiency and economy. It was necessary for them again to clear the pipe-line between Lake Vyrnwy and the Oswestry filter-beds. One of the difficulties they hoped to get rid of was the existing plumbing regulations. These were adopted in 1875, and required considerable revision, which had been in course of preparation for some years. The Engineer (Mr. Joseph Parry, M.Inst.C.E.) had had several deputations from builders and plumbers, who had explained their views as to the alterations needed. The consent of the Local Government Board would be required. It was felt that great care was needed in formulating a standard set of regulations, which should continue in operation for many years, and which should fully represent the results of the experience gained during the long period that had elapsed since the last revision in 1875. The most important and interesting part of the Committee's work in the coming year related to afforestation. It was expected that the conditions upon which the Treasury would grant a loan for afforestation on the Liverpool catchment areas would be received within the next fortnight. If, as was probable, the conditions were favourable, and the preliminary schemes submitted to the Development Commissioner were approved, it would be necessary at once to commence the preparation of a complete working plan, and to organize and start the planting on a sound economic basis which would ensure ultimate success. With respect to the rating of watersheds, notices had now been received of an additional rate of £1 per acre to be imposed upon the Rivington catchment area, under conditions which would raise a clear issue between the rating authority and the Corporation. As the Committee knew, there was already a case somewhat related to this—although it was partly on a side issue—which had been through the Courts, and was awaiting immediate hearing in the House of Lords. This case, however, did not raise the main issue. The preparation of evidence and of drawings to illustrate the position would for some time place a considerable strain upon the department. In this connection they might fairly look to the newly-constituted Municipal Water-Works Association to assist them in resisting a claim which would have a far-reaching effect upon all water-works undertakings.

METROPOLITAN WATER BOARD.

Proposed New Offices—The Deficiency Rate.

At the Meeting of the Metropolitan Water Board last Friday, a report was presented by the General Purposes Committee, in which they recommended that they should be authorized to negotiate for the acquisition of the freehold of the King's College Hospital site and buildings in Portugal Street, Lincoln's Inn Fields, for the purpose of converting the buildings into new central offices for the Board. The Committee stated that the hospital would shortly be removed to Denmark Hill, and the present buildings would, they understood, be vacated in about a year's time. The hospital stood on what was practically an island site, with an area of about 48,000 square feet. The premises afforded ample accommodation not only for the existing staff of the Board but for future requirements; and additional space could readily be provided for further expansion. The question was one of pressing importance. The Board could not complete their organization until they had adequate office accommodation; and this was at present entirely inadequate. The Committee were impressed with the opportunity of meeting the needs of the Board by a moderate outlay; and if the property could be acquired at a reasonable cost, they considered that the buildings, which had been inspected by the heads of departments and the members of the Committee, would be in every way suitable. The presentation of the report led to a discussion, in the course of which the Committee's suggestion was strongly opposed by Mr. Fitzroy Doll (an architect); and the matter was adjourned.

The Law and Parliamentary Committee recommended that a Bill containing provisions for levying a deficiency rate should be promoted next session. The Finance Committee explained that the Bill related to an amount of about £210,000; and before it could become law, the deficiency might be about £300,000. They recommended that a provision should be inserted permitting the liquidation of the deficiency to be spread over a short term of years, and that the Board should have power to borrow for the purpose. The Chairman of the Finance Committee (Mr. A. H. Tozer) said he estimated that by 1914 the deficiency would amount to £350,000; and it was proposed to spread this sum over a period of five years. The discussion on the recommendations was adjourned.


THE PROOF—
IS IN THE HEATING.
The Radiator with a big name
FOR OVER TEN YEARS THE "ST. ANDREW" RADIATOR has been on the market. Year by year, as its advantages have been recognized, the sales have enormously increased, and, where properly installed on the basis given in our lists, not a single case of insufficient heating has arisen.
Only by means of the steam principle can automatic control of the gas be effected, and economy with comfort ensured.
JOHN WRIGHT & CO.,
BIRMINGHAM.
Write for booklet "Warmth at Will"
St. Andrew

WATER SUPPLY OF GREAT TOWNS.

At the Opening Meeting last Wednesday for the present session of the Manchester Association of Students of the Institution of Civil Engineers, the President (Mr. H. P. Hill, M.Inst.C.E.) devoted his address to the subject of water supply.

Dealing with modern aspects of the engineering problem, the President said public authorities, having a tendency to make the standard of purity of water more and more stringent, had not the slightest compunction in transferring to the engineer the responsibility for attaining and maintaining the standard. No city of this country had so far installed a complete system for giving one quality of water for trade and another for domestic purposes; so that the whole of every water supply had to be suitable for dietetic uses, and had therefore to be drawn, as far as possible, from an area devoid of population and cultivation. The streams coming down from such areas were often of great size in foreign countries; and a supply might be taken from them which would not only be sufficient in dry weather, but would also be appropriated without unjustly affecting other interests. But such conditions were exceptional in this country; and the rainfall had to be impounded and conserved as it fell. The selection of a watershed for engineering depended, therefore, on the facilities for enabling reservoirs to be constructed economically. Such gathering-grounds having been already utilized in the neighbourhood of large cities and towns, the question of making extensions had come to be of considerable difficulty; modern sites which were suitable being often those which had been rejected by engineers in former days on account of the difficulties and cost involved. It was for reasons such as this that in comparatively recent times the larger communities had been obliged to seek their means of supply at a considerable distance; and this tendency would develop in the future.

Slough Water-Works Loans.—At the last monthly meeting of the Slough Urban District Council, the Water Committee reported that, after prolonged negotiations, loans for the purpose of taking over the water-works had been arranged as follows: £50,000 with the Ecclesiastical Commissioners, at £3 17s. 6d. per cent.; and £50,000 with the Wesleyan and General Assurance Society, Birmingham, at £3 17s. per cent.—being an average rate of £3 17s. 3d. per cent. The Committee recommended that the Council should pass a formal resolution for carrying out these loans, as required by the respective tenders; and this was agreed to. The Chairman (Mr. A. Woolsey) said the effect of the resolution would be roughly that a sum of £4700 per annum for 45 years would extinguish the loan and pay the interest. The income of the water-works was £7000 a year, and he put the expenditure at £1200, though some gentlemen said it would not be so much. This left them with a balance of £1000 a year for other charges, which, in his opinion, they would require for the first ten or fifteen years.

NOTES FROM SCOTLAND.

From Our Own Correspondents.

Saturday.

Buckhaven.—Mr. Henry O'Connor has been invited by the Town Council Gas Committee to act as their expert adviser in the preliminary negotiations with the Leven and Wemyss Gas Companies.

Cullen.—At the monthly meeting of the Town Council held on Monday, permission was granted to the Gaslight Company to lay pipes through the links to Portnockie.

Denny.—Among the recommendations approved by the Denny Town Council on Tuesday was one dealing with slot-meter collections, in the following terms: That the ordinary quarterly collection of slot-meters be discontinued, and collection should proceed continuously from week to week, in such a way that the whole district would be completed by the end of each quarter.

Fraserburgh.—On Saturday, a woman committed suicide by breaking a temporary gas-pipe which was lying at the side of her bedroom wall and putting the end of it in her mouth.

Inverurie.—At the meeting of the Town Council on Monday, a letter was submitted from the Secretary of the Inverurie Gas Company regarding the proposed purchase of the gas-works. The Directors, while thanking the Council for their offer, could not see their way to recommend its acceptance to the shareholders. After a brief discussion, the Council agreed to drop the matter meantime.

Peterhead.—A special meeting of the Town Council was called on Tuesday for the purpose of opening tenders and arranging the contract for the construction of the additional reservoir at Forehill. Provost Leask presided, and Mr. W. D. Ironside, of Aberdeen, the Engineer of the Water-Works, was in attendance. The ground has just been purchased. The capacity of the new reservoir will be about 9,000,000 gallons. The lowest offer, which was accepted, was that of Messrs. John M'Adam and Son, of Aberdeen, whose tender amounted to £6936 11s. 6d. Under the contract, the work will be so far completed by April 1 next that the reservoir will be ready to contain water to half its depth.

Lymm District Council and the Water-Works.—At a special meeting of the Lymm Urban District Council held last Wednesday, it was resolved to promote a Bill next session to obtain authority to purchase by agreement the undertaking of the Lymm Water Company, enlarge the existing works, and extend the limits of supply.

Odessa Gas Supply.—The German Continental Gas Company have just concluded a contract with the town of Odessa (it only requires to be confirmed by the Ministry), by which they are to take over the gas-works there for a period of 35 years. To cope with the present demands for gas, the works are to be considerably enlarged.

AN EXCEPTIONALLY
EFFICIENT AND ARTISTIC
BURNER
THAT WILL REDUCE TARNISHING OF FITTINGS TO A MINIMUM.

ITS SPECIAL FEATURES ARE THAT:—

IT IS FITTED WITH ENLARGED AIR CHAMBER,
IT HAS A NEAT INSULATING FIBRITE HANDLE,
THE SHELL IS OF STEEL, SPECIALLY SHAPED AND FITTED TIGHTLY ON TO THE GLOBE RING TO DIVERT PRODUCTS OF COMBUSTION FROM FITTINGS,
IT HAS A LONG HEAT-RESISTING MAGNESIA NOZZLE OF SUBSTANTIAL MAKE,
AND IS

BRITISH MADE BY BEST BRITISH WORKMANSHIP.

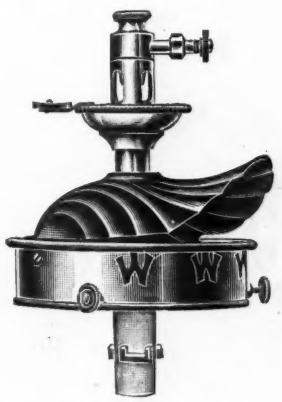
WE STRONGLY RECOMMEND THIS BURNER TO GAS COMPANIES FROM EVERY POINT OF VIEW.

Further Particulars and Prices will be seen in the New Welsbach Catalogue (page 25) or can be obtained from:—

THE WELSBACH LIGHT CO., Ltd., KING'S CROSS, LONDON.

IRISH DEPOT (Wholesale only); 197, GT. BRUNSWICK ST., DUBLIN.

The Best Mantles for all Purposes are those bearing the Registered Trade Mark, "AUR"
WELSBACH UPRIGHT MANTLES ARE C, CX, & PLAISSETTY.



No. 505.

THE
NEW
Welsbach
SHELL
BURNER.

CURRENT SALES OF GAS PRODUCTS.

Sulphate of Ammonia. LIVERPOOL, *Nov.* 16.

There is no new feature to comment upon in the situation of this article, consumers remaining somewhat apathetic, and values continuing to have a drooping tendency. The demand from the United States is comparatively small, and the requirements from other countries are not sufficient to bring about any reaction in the market. The closing quotations are £13 16s. 3d. per ton f.o.b. Hull, £13 17s. 6d. per ton f.o.b. Liverpool, and £13 18s. 9d. per ton f.o.b. Leith. Producers maintain a firm attitude as regards delivery over the first six months of 1913; but no further first-hand transactions have been reported, and it has transpired that there are middlemen willing to sell for this period at about 5s. per ton less than makers will accept.

Nitrate of Soda.

The market for this material is quietly steady, and holders on spot still require 11s. 9d. per cwt. for ordinary and 11s. 10½d. for refined quality.

LONDON, *Nov.* 18.

Tar Products.

There has been very little business doing in the market for tar products during the past week. Pitch has again weakened; and several sales are reported at lower prices for prompt and delivery over next year. Benzols are difficult to sell for near delivery unless a lower price is taken. Solvent and heavy naphthas remain fairly steady, though there is not much business doing. Crude carbolic is in a very unsettled state. Nominally, the value is not more than 1s. 11d. to 2s. per gallon, and actual consumers will not even pay these prices. Several sales have, however, been reported for prompt delivery at over 2s., which it can only be concluded are for covering-in purposes. Creosote is very firm; and the inquiry for near and forward delivery is quite good.

The average values during the week were: Tar, 26s. 9d. to 30s. 9d. Pitch, London, 43s. to 44s.; east coast, 43s. to 43s. 6d.; west coast, Clyde, 43s. to 44s.; Manchester, 42s. 6d. to 43s.; Liverpool, 42s. 6d. to 43s. 6d. Benzol, 90 per cent., naked, London, 11d. to 11½d.; North, 10d. to 10½d.; 50-90 per cent., naked, London, 11d.; North, 10½d. to 11d. Toluol, naked, London, 11½d. to 1s.; North, 11d. to 11½d. Crude naphtha, in bulk, London, 5½d. to 5¾d.; North, 5d. to 5¼d. Solvent naphtha, naked, London, 1s. 1½d. to 1s. 2d.; North, 1s. 1½d. to 1s. 2d. f.o.b. Heavy naphtha, naked, London, 11½d. to 1s. f.o.b.; North, 10½d. to 11d. f.o.b. Creosote, in bulk, London, 3⅛d. to 3¼d.; North, 3d. to 3⅛d. Heavy oils, in bulk, 3⅜d. to 3½d. Carbolic acid, casks included, 60 per cent., east coast, 1s. 11d. to 2s.; west coast, 1s. 10½d. to 1s. 11d. Naphthalene, £5 to £9; salts, 45s. to 50s., bags included. Anthracene, "A" quality, 1½d. to 1¾d. per unit, packages included and delivered.

Sulphate of Ammonia.

There has been little or no business doing in this article during the past week; and it is not possible to make sales unless lower prices are accepted. Outside London makes are £13 5s.; Hull, £13 17s. 6d. to £13 18s. 9d.; Liverpool, £13 18s. 9d.; Leith, £14; Middlesbrough, £13 18s. 9d.

COAL TRADE REPORTS.

Northern Coal Trade.

There is a good demand for coals, though the stormy weather has interfered with the shipment, and delayed work in a few cases. In the steam coal trade, prices are lower in a few instances. Best Northumbrian steam coals are about 14s. per ton f.o.b., second-class steams are near 13s., and steam smalls from 9s. 9d. to 11s. Production is now full, and is well taken up. In the gas coal trade, best Durhams are about 15s. per ton f.o.b.; and seconds are from 14s. For "Wear" specials, the price is from 15s. 9d. per ton; and this class is now somewhat scarce. As to contracts, there have been some arranged for Genoa and other Italian ports at about 28s. per ton for best gas coal, delivered there; while for delivery next month up to 29s. per ton is asked. For delivery during the first quarter of next year, about 26s. 10d. has been accepted for some large cargoes; and other similar sales are in negotiation. Dearer coal and high freights, however, make the users cautious of long commitments. In the coke trade, prices are higher. Gas coke is firm at about 23s. 6d. per ton f.o.b. in the Tyne or Wear—the output having increased steadily of late.

Scotch Coal Trade.

There is scarcely any change to report in the Scottish coal trade since last week. There is a firmer tone, if anything, in the export market. On Friday, on the Glasgow Coal Exchange, the prices quoted f.o.b. Glasgow were: Steam coal, 11s. 6d. to 12s.; splint, 14s. to 14s. 6d.; ell, 12s. 3d. to 12s. 6d.; trebles, 12s. 6d. to 13s.; and doubles and singles, 12s. to 12s. 6d.

Higher Prices for Gas Coals.

Under this heading an extract appeared in the "JOURNAL" last week from the "Newcastle Daily Chronicle." This referred to the price at which the Stockholm Gas Company's coal contract for the ensuing year had been placed. Our own correspondent also alluded to the matter. On the same subject, Mr. G. J. Eveson, of Birmingham, has written to say, in regard to the statement made in the paragraph that the Stockholm gas coal contract was concluded at a price more than 4s. per ton higher than last year's contract, that he considers this as "somewhat misleading." He continues: "Coals are not increased in price 4s. per ton. Even allowing, however, that Stockholm have purchased at this advance, the matter of whether such advance foreshadows the strength of the gas coal market next year remains to be seen. I think, however, that if the big advance has been paid, it is for a different quality than previously purchased, and a quality much superior."

COAL STRIKE *VERSUS* WATER GAS PLANTS.

Have you considered the advantages of a

WATER GAS PLANT

for your own Works as adopted at

CLEETHORPES GAS-WORKS	..	Oil or Benzol Carburetting.	
CWMBRAN	,, ..	Benzol	,,
CHELMSFORD	,, ..	Oil	,,
FELIXSTOWE	,, ..	Benzol	,,
ILFRACOMBE	,, ..	,,	,,
NEWTON ABBOT	,, ..	Oil	,,
NEW MILLS	,, ..	,,	,,
PRESCOT	,, ..	Tar	,,
RUSHDEN	,, ..	Benzol	,,
SNODLAND	,, ..	Tar	,,
TYLDESLEY	,, ..	Oil	,,
BARKING	,, ..	,,	,,

Plants made from 50,000 cubic feet per day upwards and to suit local conditions.

Prices and Particulars from—

R. & J. DEMPSTER, LTD., MANCHESTER.

London Office: 165, Gresham House, Old Broad Street, E.C.

Sale of Stocks and Shares.

At the Mart, Tokenhouse Yard, E.C., last Tuesday, Messrs. A. & W. Richards offered for sale two new issues of capital by order of Directors. The Gravesend and Milton Water Company wished to place 400 £20 preference shares (4½ per cent.); and they were all taken up at £21 2s. 6d. to £21 7s. 6d. each. The other new issue was by the Bognor Gas Company, and it consisted of additional consolidated ordinary "A" stock and 4½ per cent. perpetual debenture stock. The former ranks for a standard dividend of 5 per cent., subject to the sliding-scale; and the existing similar stock carries 5¾ per cent. It was all sold at £105 to £107 10s. per £100, *cum div.* as from the 1st prox. The debenture stock was placed at par. On the same occasion, some ordinary stock of the Herne Bay Water Company, ranking for a maximum dividend of 7 per cent., but carrying 6 per cent., fetched from £135 10s. to £136 per £100 of stock.

Reduction in Price at Redhill.—Following a reduction of 3d. per 1000 cubic feet in the price of gas in the out-districts of the Redhill Gas Company last January, it has been decided to further reduce the price by 3d. on Jan. 1 next. This will bring the price throughout the district to a uniform figure of 3s. 6d. per 1000 cubic feet.

Sulphate of Ammonia in Japan.—According to the Belgian Consul at Kobe, there is an opening for sulphate of ammonia in Japan. It is stated that Chilian nitrate is now quoted at Osaka at 180 yen (the yen being equivalent to 2s. 0½d.) per ton; and it is estimated that sulphate of ammonia can profitably be employed in Japan as a fertilizer when the price of nitrate exceeds 100 yen per ton.

German Gas-Engine Trade.—At the last general meeting of the Deutz Gas-Engine Company, the Chairman stated that the demand for engines was very brisk. From the commencement of the current financial year to the end of October, the orders booked exceeded those secured during the corresponding period of last year by 608,000 marks; and the total orders on the books at the end of October were 1,600,000 marks in excess of those at the corresponding period of 1911. Gas-engines, therefore, continued to find a growing market, in spite of the arrival of the electric motor. There was every prospect that the current year would be a good one.

Electric Light Failure at Heywood.—Heywood had an extraordinary experience last Friday evening. About five o'clock something went wrong with the electricity supply, with the result that the tram cars were temporarily brought to a standstill, and the mills, shops, and public buildings dependent on electricity for lighting purposes were thrown into darkness. Much inconvenience was caused, and the cotton workers had to leave the mills before the appointed time. Some curious sights were witnessed in the principal thoroughfares. Many large trading establishments, including the General Post Office, had to resort to candles; and a chapel bazaar, thrown into darkness, had to bring into use a similar means of lighting.

Darwen Water Supply.—Notice has been given by the Darwen Corporation preparatory to commencing, in two months' time, the construction of water-works, including a service reservoir with a capacity of 100,000 gallons, at Bull Hill, to accommodate the supply which Darwen is to receive daily from the Bolton Corporation, when the reservoir of the latter at Delph is completed.

A London Club in Darkness.—Referring to the above incident, which is dealt with in our "Editorial Notes," the "Engineer" last Friday said: "A single candle in the middle of a large unlit hall makes almost as much towards sociability as a camp fire in a desert. It was no doubt for this reason that the Whitehall Club, known well for its genial hospitality, arranged that all the lights should be extinguished during the awkward quarter-of-an-hour that precedes dinner! The occasion was one of some importance, for Mr. Elliott-Cooper, the President of the Institution of Civil Engineers, was invited to the first house dinner of the season to receive the felicitation of the club on his election."

Co-Partnership in Business.—In connection with the recent meeting of the Labour Co-Partnership Association in Birmingham [see *ante*, p. 526], a deputation from the Association attended a meeting of the Birmingham Chamber of Trade last Tuesday afternoon. Among the speakers was Mr. Charles Carpenter, who mentioned the interesting fact that in the late strike of lightermen and others in the Port of London the barges of the gas companies with whom co-partnership was in operation were the only ones at work on the Thames. The attitude of the working classes to employers was not one of friendliness; it was one of distrust. One of the advantages of co-partnership was that it provided opportunities for educating the working classes as to the conditions under which the industry of the country was carried on. It also provided for representation on the board of management.

Benzol for Motor Driving.—Writing on this subject in the "Daily Mail" last Tuesday, Mr. T. Thorne Baker, F.C.S., F.R.P.S., whose article on "Gaslight as an Ideal Illuminant" appeared in the "JOURNAL" for the 29th ult. (p. 359), asked why, with the possibilities of a fuel for motor traffic at the price of 1d. per gallon, motorists go on indefinitely using petrol at exorbitant prices. He said: "Benzol is one product that can be used quite easily as a substitute for petrol; and it requires but little modification of the existing carburettor. Benzol is obtained by the distillation of the crude naphtha, which is a bye-product in coal-tar manufacture. But a difficulty would soon arise owing to the limitations of the possible supplies, though an enormous increase in these supplies would result if a greater demand arose. It might, however, with advantage be utilized as far as possible as a competitive product; but it would be far better to mix it with alcohol, and so have a very cheap fuel that has been rightly termed 'ideal' by experts. Alcohol, if produced on a large scale from wood by means of fermentation, could, it is stated, be turned out commercially for 1d. per gallon. Though it has certain drawbacks, it possesses so many good qualities that the neglect with which it has been regarded is surprising."

"Syphon" Principle is "Correct" Principle.

The principle of the "SYPHON STOVE" is entirely different from the ordinary Condensing Stove—it is the "Correct Principle." It draws in the cold air from the room and diffuses it into the atmosphere as PURE HEATED AIR, condensing the products scientifically within the stove and effecting a circulatory movement which prevents "drying" effects and subsequent stagnation.

Clark's patent Syphon Stoves

are recommended by the Medical Profession especially for all rooms not provided with flue outlet, and its "Correct" principle enables you to introduce it with perfect safety where many other heaters have failed to give satisfactory service.

May we send you supplies of our convincing literature?

Clark's Syphon Stove Co., Ltd.,

132, Queen Victoria St., E.C. Academy Street, Warrington.

THE ONLY HYGIENIC HEATER WHICH DISPENSES WITH FLUE :: :: OUTLET :: ::

Torquay Water Undertaking.—At a meeting of the Torquay Town Council held yesterday week, it was decided that the necessary notices should be given with a view to beginning the laying of the proposed new pipe-line. This work is to be undertaken to provide for contingencies; many years having elapsed since the older of the two existing mains was laid. The cost of the new pipe will be about £50,000; and it is intended that the work shall be carried out in sections, and the expense spread over several years. With reference to the proposed afforestation of the watershed, a letter was read from the Development Commissioners, stating that they were prepared to approve of the project in principle, and to recommend a loan from the development fund for the purpose. They suggested that any scheme should apply to the whole catchment area, and that a detailed survey should be made. The Town Clerk was instructed to obtain further particulars with regard to the loan.

West Ward (Westmorland) Water Supply.—The Rural District Council of West Ward have applied to the Local Government Board for sanction to borrow £35,600 for the purposes of water supply for the contributory places of Askham, Bampton, Bolton, Broughton, Cliburn, Clifton, Crosby Ravensworth, Great Strickland, King's Meaburn, Little Strickland, Lowther, Morland, Newby, Shap Rural, Sleagill, and Thrimby, including the construction of a reservoir to hold 200,000 gallons on Windrigg Hill, in the township of Newby, and the execution of works in the urban district of Shap. The Overseers of Askham and Crosby Ravensworth have appealed to the Board against the apportionment which has been made by the Rural Council of the cost of the works, which will be for the common benefit of the contributory places mentioned. The Board have directed an inquiry into the subject; and Mr. A. W. Brightmore will hold it at Hackthorpe next Thursday. Mr. J. Graham is Engineer for the scheme.

"Evolution of Domestic Lighting."—This was the title of a lecture delivered before the Belfast Natural History and Philosophical Society, by Mr. A. M'I. Cleland. He traced the history of lighting from the pine candle to the torch, the flambeau, the ordinary lamp, the rushlight, and the candle; and, observing that the era of coal gas might be said to have opened in 1800, he mentioned that it was first experimented with by the Rev. John Clayton, a Dean of Kildare, who produced inflammable air or spirit. It was reserved, however, for William Murdoch, an Ayrshire man, to use gas in a practical way some eight years previously at Redruth. From one candle they had now reached 60 candles per cubic foot. In 1880, they entered the era of incandescence; and the output of mantles to-day was some 400 millions per annum. In Belfast, the cost of gas ran to about ½d. per 1000 lighting hours per candle; and for all purposes they believed there was no light so economical as that obtained from ordinary coal gas with a good incandescent mantle. The lecture was illustrated by experiments and by lantern pictures. Professor Lindsay, M.D., who presided, paid a high tribute to Mr. Cleland's mastery of his subject, and said he had never heard a more interesting lecture.

APPLICATIONS FOR LETTERS PATENT.

25,235.—Potterton, T., "Gas-fires." Nov. 4.
25,243-4.—Mowbray, J. W., and Chambers, J. H., "Gas-engines." Nov. 4.
25,282.—Kent-Johnston, A. G., "Controlling the lighting and extinguishing of gas-lamps." Nov. 4.
25,310.—Price, T. E., and Turner, H. O., "Gas-burner regulating nipple." Nov. 5.
25,313.—Forrester, H. J. C., "Heating apparatus." A communication from the Rector Gas-Lamp Company. Nov. 5.
25,326.—Weston, C., "Obtaining gases from solids." Nov. 5.
25,342.—Duckham, A. M'D., "Vertical retorts." Nov. 5.
25,360.—Colas, C. L., "Mantles." Nov. 5.
25,421.—Kenyon, G. H., jun., and Ruscoe, J., and Co., Limited, "Cutting pipes under pressure and inserting valves." Nov. 6.
25,433.—Brown, J., "Gas-fires." Nov. 6.
25,443.—Murray, D., and Gibb, G., "Liquid meters." Nov. 6.
25,535.—Williamson, T. H., "Gas reflector lamps." Nov. 7.
25,547.—Keith, J. & G., "Lighting and extinguishing gas-lamps." Nov. 7.
25,557.—Halpern, A., and Pospischil, E., "Pyrophorous gas-lighting apparatus." Nov. 7.
25,570.—M'Court, C. D., and Bonecourt Surface Combustion, Limited, "Water-tube steam generators." Nov. 7.
25,593.—Liversedge, A. J., and Davidson, W. B., "Apparatus for washing gases, applicable also for distilling purposes." Nov. 7.
25,627.—M'Court, C. D., and Ellis, C., "Production of mixtures of heated vapour and products of combustion." Nov. 8.
25,628.—M'Court, C. D., "Calcining or treating material in granular form." Nov. 8.
25,629.—M'Court, C. D., and Ellis, C., "Making nitrogen and carbon dioxide." Nov. 8.
25,643.—Keith, J. & G., "Diaphragm governors." Nov. 8.
25,693.—Dakers, E. W., "Gas-testers." Nov. 8.
25,714.—Wilson, W. A., "Bunsen burner." Nov. 9.
25,715.—Carmichael, D., "Leak finder." Nov. 9.
25,720.—Patchett, W. R. F., "Gas-engines." Nov. 9.
25,778.—Simonenks, A., and Hendunen, A., "Gas-producers." Nov. 9.

Wath and Bolton Gas Undertaking.—According to a report by the Manager, the gas undertaking acquired by the Wath-upon-Dearne and Bolton Gas Board in 1909, at a cost of £66,611, has proved successful. Loans of £70,000 and £18,000 were negotiated for the purpose of securing the undertaking, and for extensions; and at the end of March last the amount outstanding was £85,650. The annual trading has resulted in net profits ranging from £1119 in 1909 to £1339 in 1911; and from April, 1911, the price of gas charged has been reduced by 3d. per 1000 cubic feet.

NO COMPLICATED FITMENTS

are embodied in the design of our Fires (see illustration), which can be easily and instantly taken to pieces.

PARKINSON FIRES

are of Elegant Design, Simply Constructed, Hygienic, Inexpensively Maintained, and are

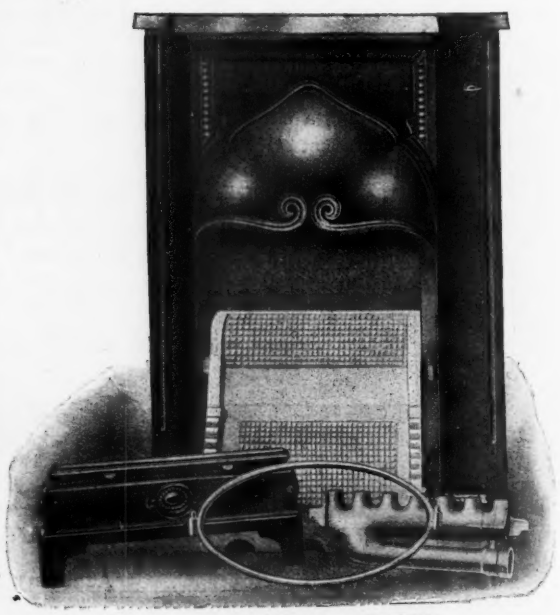
PARTICULARLY SUITABLE

for

HIRING PURPOSES.

They are on most Gas Undertakings' Hire List.

THE PARKINSON STOVE CO., Ltd.,
BIRMINGHAM & LONDON.



THE "CRETAN" and PARTS.
One of the P.S.C. Series.

Treatment of Strood Water.—The inhabitants of Strood have met to consider the action of the Rochester Corporation with regard to the water supply of the town—alarm having been caused by the treatment of the water, in consequence of an outbreak of typhoid, which was believed to be water-borne. The Strood representatives on the Council were present, and explained the means which the Corporation had adopted for first treating and then filtering the water, which they contended would then be a perfectly pure supply. The meeting decided, however, that such a system of water was unsuitable as a permanent supply, and demanded that the Corporation should be called on to take expert advice as to the practicability of obtaining a pure supply. It was decided that a copy of the resolution should be sent to the Local Government Board.

Margam Gas Supply.—At the meeting of the Margam Urban District Council on Monday last week, the Chairman (Major Gray) reported that a deputation had waited upon the Aberavon Corporation, but the latter body would not entertain the idea of supplying gas in bulk for less than 3s. 2d. per 1000 cubic feet, unless the Council entered into an agreement for a three years' supply. Mr. Lowther said negotiations were proceeding for the erection of new works at Port Talbot, and, if successful, they would be able to supply gas in the district at a much cheaper rate than that at which the Council or the Corporation could sell it. Eventually it was agreed to ask the Corporation for their terms for a seven years' supply in bulk. The Engineer was instructed to prepare plans and specifications for the new works.

The Fylde Water Board have instructed their Engineer to proceed with the surveys and estimates for the construction of a storage reservoir in the Hodder Valley, and a service reservoir at Westby.

The Ashton Gas Company have extended their area to include the whole of the adjoining township of Hurst, part of which has hitherto been lighted from the gas-making plant at the Hurst Cotton Mills. The Company have decided to supply gas-fires on simple hire from 1s. 6d. per quarter, and to fix and maintain them free. A special show of fires, radiators, &c., is now being made by the Company at their rooms in Oldham Road, Ashton.

We have received from the Eureka Pump Company, of Glasgow, a copy of their new catalogue (No. 214) of "Eureka" steam and power pumps. Full particulars are furnished of various types of pumps, which are very effectively illustrated. At the end of the catalogue are a number of useful tables, and a telegraphic code. The Company have a branch office in Victoria Street, Westminster.

A meeting of the creditors of Mr. William Key, trading as the Centenary Gas Company, of 109, Hope Street, Glasgow, gas apparatus manufacturer, was held at the offices of Messrs. John Mann and Sons, Glasgow, when an approximate statement of affairs presented showed liabilities of £759 15s. 9d. The assets were estimated to realize £630 15s. 10d., from which had to be deducted £150 for preference claims; leaving net assets of £480 15s. 10d. or a deficiency of £278 19s. 11d. It was pointed out that the estate showed an apparent dividend of 12s. 8d. in the pound, subject to the expenses of realization. The debtor was the patentee of the "Centenary" air-gas generator; but, for the purposes of the statement, no value had been placed upon the patent. The creditors decided that the debtor should be given time in which to make an effort to sell the patent, which was said to be a good and practicable one, and might realize sufficient to pay the whole of the creditors in full.

The Shopping Supplement to the "Aldershot News" for last Friday contains an effective advertisement of the Gas, Water, and District Lighting Company. It appeals specially to mothers, and emphasizes the value of the ever-ready gas-fire in affording protection against chills which are calculated to endanger the health of children. The pictorial portion of the advertisement shows a chubby nude child enjoying to the full the genial warmth afforded by a gas-fire. Referring to the reduction in the price of gas recently announced [see *ante*, p. 461], the following remarks are made: "Not a little of the advancement of Aldershot may be attributed to the excellence of the service rendered by the adequate supply of good water and the cheap gas, now reduced to 2s. 4d. per 1000 cubic feet, with a rebate on that used for heating and lighting. The provision made for gas heating and cooking places these conveniences within the reach of all; and no trouble is spared in suiting customers' requirements in these matters."

GAS COMPANIES' STOCK AND SHARE LIST.

A delightful change came over the Stock Exchange; and last week was one of the most cheerful it has had for many a long day. The mainspring of the improvement was the fairer aspect of relations between the Great Powers over the Eastern Question. An apparently sincere desire not to quarrel among themselves and to aid in re-establishing peace between the belligerents, was an intense relief. Added to this was a healthier state of the markets, both home and foreign, and a smooth settlement of our fortnightly account. Public confidence was illustrated by a rise of 1¼ in Consols, and a general demand for high-class investments. But the improvement did not come all at once; for on the opening day the tone became dull, and business kept very quiet upon apprehension touching Balkan affairs. Government issues bore up pretty well; but the rest showed weakness. Tuesday was more active, and began to gather strength, as the Eastern sky looked brighter. Gilt-edged were in great form, and Consols rose ¼ in response to the strong demand. Railways advanced; and the Foreign Market was cheerful. Wednesday's tone was excellent; and all markets were brisk and buoyant. Consols gained ⅜, and Rails rose in spite of some profit-snatching. Americans were much improved. On Thursday, a better tone in Austro-Servian communications imparted satisfaction; and all the leading markets were strong. Buying orders put Consols up higher, and Rails were in good demand. Friday saw markets still going strong; and there was not much of the usual realizing. Consols advanced ⅜, and Rails rose, though a little of the cream was taken off by late sales. Saturday brought a slight reaction—late rises offering irresistible temptation to secure profits. The markets were, however, strong enough to make light of it. Consols closed ⅛ lower at 75⅛ to 75⅜. In the Money Market, there was a fair demand at times; but rates generally were easy, and discount terms relaxed before the close. Business in the Gas Market was about a moderate average, and was rather humdrum in character. General firmness was the rule; and hardly a quotation moved except for *ex div.* adjustment. In Gaslight and Coke issues, the ordinary was not very active, but was quite steady at the old prices—102⅛ to 103. In the secured issues, the maximum was marked at 82½ to 84, the preference at 100½ to 101½, and the debenture at 76¾ to 77¾. South Metropolitan supplied only half-a-dozen bargains, all within the range of 116½ and 117½. In Commercials, the 4 per cent. changed hands at 106¾ to 107½. Among the Suburban and Provincial group, Alliance and Dublin realized 76, Brentford old 260, ditto new 197½ and 201, Brighton ordinary 153½ and 154, British debenture 91½, and South Suburban 119. In the Continental companies, Imperial was done at 182 to 184 *cum div.* and at 178 and 179 *ex div.*, European at 19 to 19¾, and Tuscan debenture at 98½ and 98⅝. Among the undertakings of the remoter world, Bombay marked 6⅜, Monte Video 11⅜, Melbourne 99½, Primitiva from 6½ to 6⅝, and ditto preference from 5 to 5⅛.

Issue.	Share	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
1,551,868	Stk.	Oct. 11	5	Alliance & Dublin Ord.	76–81	..	6 3 5
374,000	Stk.	July 12	4	Do. 4 p.c. Deb.	89–91	..	4 7 11
250,000	5	Oct. 11	7½	Bombay, Ltd.	6⅜–6⅞	..	5 9 1
50,000	10	Aug. 29	15	Bourne- 10 p.c.	28–29	..	5 3 5
332,000	10		7	mouth Gas B 7 p.c.	15⅜–16½	..	4 6 2
75,000	10		6	and Water Pref. 6 p.c.	14–14½	..	4 2 9
880,000	Stk.	Aug. 14	13½	Brentford Consolidated	257–262	..	5 3 1
330,000	"		10½	Do. New	197–202	..	5 4 0
50,300	"		5	Do. 5 p.c. Pref.	116–118	..	4 4 9
206,250	"	June 14	4	Do. 4 p.c. Deb.	96–98	..	4 1 8
218,230	Stk.	Aug. 29	11	Brighton & Hove Orig.	210–215	..	5 2 4
244,200	"	"	8	Do. A Ord. Stk.	152–155	..	5 3 3
530,000	"	Sept. 27	12½	British	44–45	..	5 11 1
120,000	Stk.	June 28	4	Do. 4 p.c. Deb. Stk.	91–93	..	4 6 0
245,771	Stk.	June 28	4	Buenos Ayres 4 p.c. Deb.	93–95	..	4 4 3
100,000	10	—	—	Cape Town & Dis., Ltd.	2–3	..	—
100,000	10	—	—	Do. 4½ p.c. Pref.	3½–4½	..	—
100,900	Stk.	June 28	4½	Do. 4½ p.c. Deb. Stk.	70–73	..	6 3 3
157,150	Stk.	Aug. 29	5	Chester 5 p.c. Ord.	110–112	..	4 9 3
1,513,280	Stk.	Aug. 29	5/9/4	Commercial 4 p.c. Stk.	106–108	..	5 1 2
660,000	"	"	5½	Do. 5 p.c. do.	101–103	..	5 3 6
475,000	"	June 14	3	Do. 3 p.c. Deb. Stk.	73–75	..	4 0 0
800,000	Stk.	May 31	4	Continental Union, Ltd.	80–83	..	4 16 5
200,000	"	"	7	Do. 7 p.c. Pref.	133–135	..	5 3 8
492,270	Stk.	—	6¾	Derby Con. Stk.	124–125	..	4 12 0
55,000	"	—	4	Do. Deb. Stk.	103–105	..	3 16 2
1,002,130	10	July 26	10	European, Ltd.	19–20	..	5 0 0
16,160,600	Stk.	Aug. 14	4/17/4	Gas- 4 p.c. Ord.	101½–103½	..	4 14 1
2,600,000	"	"	3½	light 3½ p.c. max.	81–84	..	4 3 4
4,062,235	"	"	4	and 4 p.c. Con. Pref.	99½–101½	..	3 18 10
4,531,705	"	June 14	3	Coke 3 p.c. Con. Deb.	76–78	..	3 16 11
258,740	Stk.	Sept. 13	5	Hastings & St. L. 3½ p.c.	91–93	..	5 7 6
82,500	"	"	6½	Do. do. 5 p.c.	—	..	—
70,000	10	Oct. 11	11	Hongkong & China, Ltd.	16–16½	..	6 13 4
131,000	Stk.	Sept. 13	7⅝	Ilford A and C	154–157	..	4 17 1
65,780	"	"	6½	Do. B	121–123	..	4 19 7
65,500	"	June 28	4	Do. 4 p.c. Deb.	91–93	..	4 6 0
4,940,060	Stk.	Nov. 14	9	Imperial Continental	175–180*	–½	5 0 0
1,235,000	Stk.	Aug. 14	3½	Do. 3½ p.c. Deb. Red.	86–88	..	3 19 7
200,242	Stk.	Aug. 29	6	Lea Bridge Ord. 5 p.c.	122–125	..	4 16 0

Issue.	Share	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
561,000	Stk.	Aug. 29	10	Liverpool United A.	216–218	..	4 11 9
718,100	"	"	7	Do. B.	155½–157½	..	4 8 11
306,083	"	June 28	4	Do. Deb. Stk.	100–102	..	3 18 5
63,480	Stk.	June 28	3	Maidstone 3 p.c. Deb.	69–71	..	4 4 6
75,000	5	June 14	6	Malta & Mediterranean	4⅜–4¾	..	6 3 1
250,000	100	Oct. 1	4½	Met. of Melbourne 4½ p.c. Deb.	99–101	..	4 9 1
541,920	20	Oct. 30	3½	Monte Video, Ltd.	11⅛–11⅜	..	5 19 2
1,775,892	Stk.	July 26	4½	Newc'tle&G'tesh'd Con.	99–100	..	4 7 6
529,705	Stk.	June 28	3½	Do. 3½ p.c. Deb.	86–87	+1	4 0 6
55,940	10	Aug. 29	7/7/0	North Middlesex 7 p.c.	13½–14½	..	5 1 5
800,000	Stk.	May 15	8	Oriental, Ltd.	130–133	..	6 0 4
60,000	5	Sept. 27	10	Ottoman, Ltd.	8⅛–8⅜	..	5 14 3
60,000	50	Aug. 14	13	Portsea Island B	127–130	..	5 0 0
100,000	50	"	12	Do. C	124–127	..	4 14 6
249,980	5	Oct. 11	8	Primitiva Ord.	6½–7	–⅛	5 14 4
499,960	5	June 28	5	Do. 5 p.c. Pref.	5–5½	..	4 15 3
521,600	100	June 1	4	Do. 4 p.c. Deb.	96–98	..	4 1 8
346,198	Stk.	June 28	4	River Plate 4 p.c. Deb.	93–95	..	4 4 3
275,000	5	Apl. 13	12	San Paulo, Ltd.	13–14	..	4 5 9
150,000	10	Sept. 27	6	Do. 6 p.c. Pref.	11½–12	..	5 0 0
125,000	50	July 1	5	Do. 5 p.c. Deb.	49–51	..	4 18 0
135,000	Stk.	Aug. 29	10	Sheffield A	230–232	..	4 6 2
209,984	"	"	10	Do. B	229–231	..	4 6 7
533,500	"	"	10	Do. C	229–231	..	4 6 7
90,000	10	Sept. 27	7½	South African	9–10	..	7 10 0
6,429,895	Stk.	Aug. 29	5/9/4	South Met., 4 p.c. Ord.	116–118	..	4 12 8
1,895,415	"	July 12	3	Do. 3 p.c. Deb.	⁷⁄₈–79	..	3 15 11
209,820	Stk.	Aug. 14	8½	South Shields Con. Stk.	163–165	..	5 3 0
605,000	Stk.	Aug. 14	5/16/8	S'th Suburb'n Ord. 5 p.c.	117–119	..	4 17 11
60,000	"	"	5	Do. 5 p.c. Pref.	117–119	..	4 4 0
117,058	"	July 12	5	Do. 5 p.c. Deb. Stk.	120–122	..	4 2 0
694,740	Stk.	Nov. 14	5	Southampton Ord.	102–105*	..	4 15 3
130,000	Stk.	Aug. 14	7½	Tottenham A 5 p.c.	142–145	..	5 0 0
483,940	"	"	5½	and B 3½ p.c.	114–116	..	4 19 2
149,470	"	June 28	4	Edmonton 4 p.c. Deb.	94–96	..	4 3 4
182,380	10	June 15	5	Tuscan, Ltd.	8⅛–8⅜	..	5 15 11
149,900	10	July 1	5	Do. 5 p.c. Deb. Red.	97–99	..	5 1 0
236,476	Stk.	Aug. 14	5	Tynemouth, 5 p.c. max.	115–115½	..	4 6 7
255,636	Stk.	Aug. 29	6¼	Wands- B 3½ p.c.	133–141	..	4 17 6
85,766	"	June 28	3	worth 3 p.c. Deb. Stk.	70–72	..	4 3 4

Prices Marked * are "Ex. Div."

An extraordinary incident occurred on the road leading from Sunninghill to Virginia Water last Tuesday evening. The Water Company were attending to their mains, and a deep trench had been dug for the workmen. In order to get to some stables attached to a public-house, it was necessary to cross the trench on a plank, and as a horse was being taken over, the animal slipped in, breaking the 15-inch main as it fell. The water poured out with great force, and the trench was flooded in a very few minutes; the animal being drowned before sufficient help could be obtained to get it out.

At the last meeting of the Wheatley (Doncaster) Urban District Council, the accounts for gas lighting, among which was the Doncaster Corporation account, came up for consideration. Mr. Lester Glaister asked if any progress had been made with regard to the proposal of the Corporation to supply Wheatley with electricity, and if the Council had decided to substitute this illuminant for gas. The Chairman (Mr. F. J. Clarke) replied they had decided to keep to gas. There was no improvement, either in price or light, in dealing with electricity. He understood that Bentley was no better off with electric light; and he could not advise the Wheatley Council to change.

Mr. F. J. Atkinson, a farmer, of Bury, was found on the afternoon of the 8th inst. dead in a cottage forming part of the farm buildings. He was lying on a table against the wall of the kitchen. The gas was full on; a flexible tube was fixed to the gas-bracket; and one end of it looked as though it had been in his mouth. It appears that he was in the habit of inhaling gas, in the belief that it would relieve some inward complaint from which he was suffering.

"The Evolution of Domestic Lighting" was the subject of a lecture delivered last Tuesday, at a meeting of the Belfast Natural History and Philosophical Society, by Mr. A. M'T. Cleland, who illustrated his remarks by numerous demonstrations, lantern views, and antiquarian objects. Beginning with early times, the lecturer traced his subject down to the introduction of gas, and then to the discovery of the incandescent mantle. He pointed out that at the present time the output of mantles was something like 400 millions per year. After throwing on the screen some gas-light photographs, he quoted a few figures bearing out his belief that for all purposes there is no light so economical as that to be obtained from the use of ordinary coal gas with a good incandescent mantle. Mr. Cleland was cordially thanked for his lecture.

WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Appointments, &c., Vacant.

WORKING MANAGER. No. 5657.
DRAUGHTSMAN. No. 5650.
FOREMAN SUPERVISOR AND HEAD GAS-FITTER. Calcutta Corporation. Applications by Dec. 15.
WORKING FOREMAN. Brymbo Water Company.
GAS-FIRE TESTERS. Portsea Island Gaslight Company.
SLOT-METER COLLECTOR. Wolverhampton Gas Company.

Plant, &c. (Second-Hand), for Sale.

CAST-IRON TANKS. No. 5656.

Stocks and Shares.

EAST GRINSTEAD GAS AND WATER COMPANY. By Auction. London Mart. Dec. 3.
HARROW AND STANMORE GAS COMPANY. By Auction. London Mart. Dec. 3.
HYTHE AND SANDGATE GAS COMPANY. By Auction. London Mart. Nov. 26.
KINGSTON-ON-THAMES GAS COMPANY. By Tender. Nov. 27.

Stocks and Shares—*(continued)*.

LITTLEHAMPTON GAS COMPANY. By Auction. 25, High Street, Littlehampton. Dec. 4.
LOWESTOFT WATER AND GAS COMPANY. By Auction. London Mart. Nov. 26.
NORTH MIDDLESEX GAS COMPANY. By Auction. London Mart. Dec. 10.
PINNER GAS COMPANY. By Auction. London Mart, Nov. 26.
SOUTHEND WATER COMPANY. By Auction. London Mart Dec. 3.
SOUTHGATE AND DISTRICT GAS COMPANY. By Auction. London Mart. Dec. 10.

TENDERS FOR

Coal.

NOTTINGHAM CORPORATION. Tenders by Dec. 5.

Fire-Clay Goods.

BRADFORD CORPORATION. Tenders by Nov. 28.
LEICESTER GAS DEPARTMENT. Tenders by Nov. 23.

General Stores (Cement, Lime, Bricks, &c. Earthenware Pipes, Castings, Disinfectants, Ironmongery, Brushes, Picks, Shovels, &c., &c.).

NOTTINGHAM CORPORATION. Tenders by Dec. 5.

Pipes, &c.

CLACTON URBAN DISTRICT COUNCIL. Tenders by Dec. 4.
LEICESTER GAS DEPARTMENT. Tenders by Nov. 23.

Sulphate of Ammonia Plant.

TAUNTON GASLIGHT AND COKE COMPANY.

Sulphuric Acid.

SALFORD GAS DEPARTMENT.

Tar.

SHEPPY GAS COMPANY. Tenders by Dec. 4.

Tar (Refined), Pitch, and Creosote Oil.

NOTTINGHAM CORPORATION. Tenders by Dec. 5.
SOUTHAMPTON COUNTY COUNCIL. Tenders by Dec. 9.

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office NOT LATER than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or stoppages of, PERMANENT ADVERTISEMENTS should be received by the FIRST POST on SATURDAY.

Wanted, For Sale, and Tender Advertisements, Six Lines and under, 3s.; each additional Line, 6d.

TERMS OF SUBSCRIPTION to the "JOURNAL."

United Kingdom: One Year, 21s.; Half Year, 10s. 6d.; Quarter, 6s. 6d.
Payable in advance. If credit is taken, the charge is 25s. a year.
Abroad (in the Postal Union): £1 7s. 6d., payable in advance.

All Communications, Remittances, &c., to be addressed to
WALTER KING, 11, BOLT COURT, FLEET STREET, LONDON, E.C.
Telegrams: "GASKING FLEET, LONDON." Telephone: P.O. 1571a Central.

Cloth Bound, 8vo. **Price 3s. 6d. net., Post Free in the United Kingdom.**

THE RATING OF GAS AND WATER UNDERTAKINGS,

with an Outline of General Procedure outside the Metropolis,

By ARTHUR VALON, Assoc.M.Inst.C.E.

WALTER KING, "JOURNAL" OFFICES, 11, BOLT COURT, FLEET STREET, LONDON, E.C.

OXIDE OF IRON.

O'NEILL'S OXIDE
For GAS PURIFICATION,
LARGEST SALE OF ANY OXIDE.

SPENT OXIDE PURCHASED IN ANY DISTRICT.

GAS PURIFICATION & CHEMICAL CO., LD.,
PALMERSTON HOUSE,
OLD BROAD STREET, LONDON, E.C.

WINKELMANN'S
"VOLCANIC" FIRE CEMENT.
Resists 4500° Fahr. Best for GAS-WORKS.
ANDREW STEPHENSON, 182, Palmerston House, Old Broad Street, London, E.C. "Volcanism, London."

AMMONIACAL Liquor wanted.
CHANCE AND HUNT, LTD., Chemical Manufacturers, OLDBURY, WORCS.
Telegrams: "CHEMICALS."

J. & J. BRADDOCK (Branch of Meters Limited), Globe Meter Works, OLDHAM, and 45 & 47, Westminster Bridge Road, LONDON, S.E.
WET AND DRY GAS-METERS, PREPAYMENT METERS, STATION METERS AND GOVERNORS.
REPAIRS RECEIVE PROMPT ATTENTION.
Telephones: 815 Oldham, and 2412 Hop, London.
Telegrams—
"BRADDOCK, OLDHAM," and "METRIQUE, LONDON."

DUTCH OXIDE OF IRON.

SPENT OXIDE PURCHASED IN ANY DISTRICT.

THE First Dutch Bogore Co., Ltd.,
NYMEGEN, HOLLAND.

GENERAL MANAGERS—
London and South of England:
W. T. P. CUNNINGHAM,
13, Arcadian Gardens, Wood Green, LONDON, N.
North of England, Midlands, and Wales:
J. BROWN & CO., LTD., Savile Town, DEWSBURY.
Scotland and Ireland:
J. B. MACDERMOTT, 11, Bothwell St., GLASGOW.

OXIDE OF IRON.
SPENT OXIDE PURCHASED.
BALE'S FIRE CEMENT.
PAINT FOR GAS-WORKS.
"KLEENOFF." THE COOKER CLEANER.
BALE & CHURCH, LTD.,
5, CROOKED LANE, LONDON, E.C.

TAR WANTED.
THOMAS HORROCKS & SONS, LTD.,
Albert Chemical Works,
GRANT STREET, MILES PLATTING, MANCHESTER.
Pitch, Creosote, Brick and Fuel Oils, Benzol, Solvent Naphtha, Carbolic, Sulphate of Ammonia.

TO GAS AND WATER OFFICIALS.
BEFORE Purchasing your 1912 Cycle, kindly send post-card for our CATALOGUE. Cash or gradual Payments. Speciality, Slot-Meter Copper Collector. MELROSE CYCLE CO., COVENTRY.